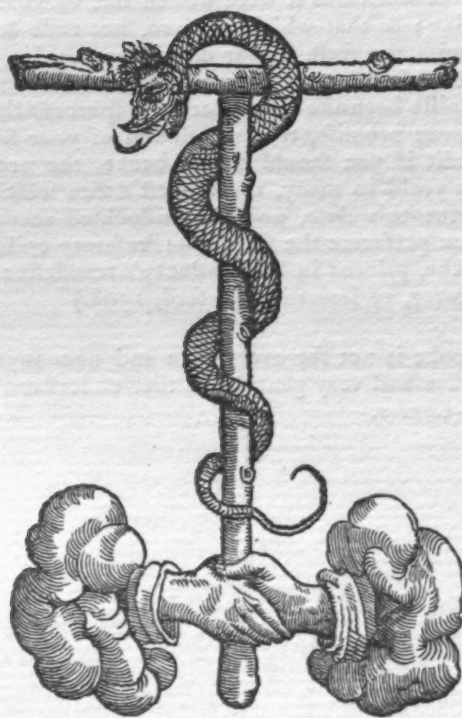


NOTES
ON THE
DE MAGNETE
OF
DR. WILLIAM GILBERT



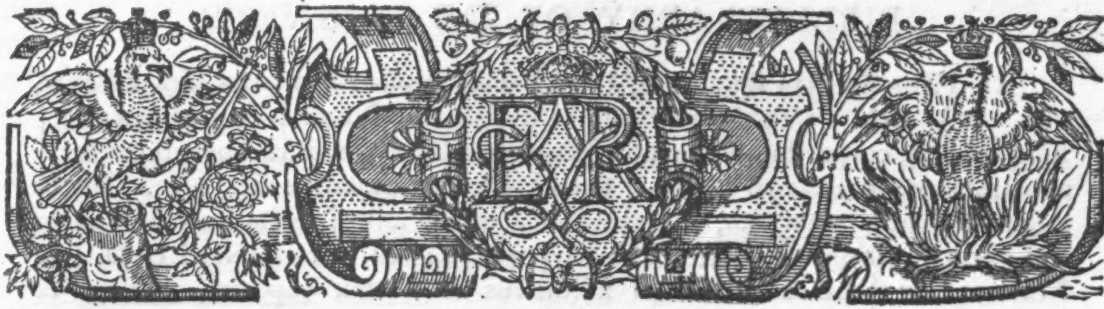
PRIVATELY PRINTED
LONDON MCM I

NOTES
DE MAGNETE
"For out of olde feldes, as men feith,
Cometh al this newe corn fro yeer to yere ;
And out of olde bokes, in good feith,
Cometh al this newe science that men lere."

—*Chaucer.*

"I finde that you have vsed in this your translation greate art, knowledge, and discretion. For walking as it were in golden fetters (as al Translators doe) you notwithstanding so warilie follow your Auctor, that where he trippeth you hold him vp, and where he goeth out of the way, you better direct his foote. You haue not only with the Bee sucked out the best iuyce from so sweete a flower, but with the Silke-worme as it were wouen out of your owne bowels, the finest filke ; & that which is more, not rude & raw filke, but finely died with the fresh colour of your owne Art, Invention, and Practise. If these Adamantes draw you not to effect this which you haue so happilie begunne : then let these spurres driue you forward : viz. Your owne promise, the expectation of your friends, the losse of some credit if you should steppe backe, the profit which your labours may yeeld to many, the earnest desire which you yourfelfe haue to reuiue this Arte, and the vndoubted acceptation of your paines, if you performe the same."—(Prefatory epistle of John Case, D. of Physicke, printed in R. Haydocke's translation of *The Artes of Curious Painting*, of Lomatius, Oxford, 1598.)

"This booke is not for every rude and unconnyng man to see, but for clerkys and very gentylmen that understand gentylnefs and scyence."—*Caxton.*



BIBLIOGRAPHY OF *DE MAGNETE*.

I. (**The London Folio of 1600.**) *Fol. *j. title* GVILIELMI GIL | berti colcestren | fis, medici londi- | nensis, | DE MAGNETE, MAGNETI- | cisque corporibvs, et de mag- | no magnete tellure; Physiologia noua, | plurimis & argumentis, & expe- | rimentis demonstrata. | *Printer's Mark* | Londini | excudebat Petrus Short anno | MDC. || **j verso* Gilbert's coat of arms. || **ij Ad Lectorem* || **iij verso* Ad gravissimum doctissimumque . . . || **vj* Verborum quorundam interpretatio. || **vj verso* Index capitum. || p. I. GVILIELMI GILBERTI | DE MAGNETE, LIB. I. || p. 240. FINIS. | Errata. Without any colophon, printer's Mark, or date at end. *Folio. 8 ll. of preliminary matter. ABCDEFGHIKLMNOPQRSTV, all ternions, making 120 numbered leaves. One blank leaf at front and one at end. Page 114 at end of Liber II. blank. A folded woodcut plate inserted between p. 200 and p. 201. Woodcut initials, headlines and diagrams. All known copies except one have ink corrections in several pages, particularly pp. 11, 22, 47.*

II. (**The Stettin Quarto of 1628.**) *Four preliminary unnumbered leaves, viz. (1) Bastard title* GULIELMI GILBERTI | Tractatus | DE MAGNETE || *verso* blank; (2) *Engraved title. TRACTATVS | Siue | PHYSIOLOGIA NOVA | DE MAGNETE, | MAGNETICISQVE CORPO- | RIBVS ET MAGNO MAGNETE | tellure Sex libris comprehensus | ã | Guilielmo Gilberto Colcestrensi, | Medico Londinensi | . . . Omnia nunc diligenter recognita & emen- | datius quam ante in lucem edita, aucta & figu- | ris illustrata operâ & studio | Wolfgangi Lochmans I.U.D. | & Mathemati: | Ad calcem libri adjunctus est Index Capi- | tum Rerum et Verborum locupletissimus | EXCVSVS SEDINI | Typis Götzianis Sumptibus | Ioh: Hallervordij. | Anno MDC.XXVIII || verso* blank; (3) *Præfatio*; (4) *Amicorum Acclamations (verses) || verso* blank. *Sig. A* Ad Lectorem Candidum. *Sig. A2 verso* Ad Gravissimum Doctissimumq Virum. *Sig. B2* Verborum quorundam interpretatio. *Verso* blank, followed by twelve engraved plates numbered I. to XII. *Sig. B3* is numbered as p. 1, and begins GVILIELMI GILBERTI | DE MAGNETE. | LIBER I. *Sig. C* begins as p. 5; *Sig. D* as p. 13; and so forth. The collation therefore is: 4 ll. unnumbered, ABCDEFGHIKLMNOPQRSTVXYZAaBbCcDdEeFfGgHhIiKkLlMm, all fours. *Pagination ends on p. 232, which has Sig. H3 in error for Hh3, being the end of the text. Verso of Hh3* blank. *Index capitum begins fol. [Hh4] and with Index Verborum continues to verso of Mm3. Last leaf [Mm4] contains Errata, and instructions to binder to place plates: verso* blank. *Quarto. Woodcut initials and diagrams. Without any colophon, printer's Mark, or date at end. In some copies the engraved title differs, having the words Ioh: Hallervordij. replaced by the word Authoris.*

III. (**The Stettin Quarto of 1633.**) *Four preliminary unnumbered leaves, viz., (1) title. Tractatus, five Physiologia Nova | de | MAGNETE, | Magneticifq; corporibus & magno | Magnete tellure, sex libris comprehensus, | a GUILIELMO GILBERTO Colce- | strensi, Medico Londinenfi. | . . . Omnia nunc diligenter recognita, & emendatius quam ante | in lucem edita, aucta & figuris illustrata, opera & studio D. | WOLFGANGI LOCHMANS, I.U.D. | & Mathematici. | Ad calcem libri adiunctus est Index capitum, Rerum & Verborum | locupletissimus, qui in priore æditione desiderabatur | SEDINI, | Typis GOTZIANIS. | ANNO M.DC. XXXIII. || verso blank; (2) Præfatio; (3) Amicorum acclamationes (verses) || verso Claudianus de Magnete (verses); (4) *ibid.* Sig. A Ad Lectorem Candidum. Sig. A2 verso Ad Gravissimum Doctissimumq. Virum. Sig. B2 Verborum quorundam interpretatio; verso blank. Sig. B3 is numbered as p. 1, and begins GVILIELMI GILBERTI | DE MAGNETE. | LIBER I. Sig. C begins as p. 5; Sig. D as p. 13; and so forth. The Collation therefore is: 4 ll. unnumbered, A to Mm, all fours. Pagination ends on p. 232, which bears Sig. H3 in error for Hh3. Verso of Sig. Hh3. Errata. Index capitum begins Hh4, and with Index Verborum extends to verso of Mm3. The last leaf [Mm4] bears the Instructions to binder, with verso blank. There is no colophon, printer's Mark, or date at end. Quarto. Woodcut initials, and diagrams. Twelve etched plates of various sizes inserted.*

With the exception of the preliminary matter and the Instructions to binder, the pagination is the same as in the edition of 1628, the pages in the body of the work being reprinted word for word; though with exceptions. For example, p. 18 in Ed. 1633 is one line shorter than in Ed. 1628. The etched plates are entirely different. It has been thought from the pagination being alike that these two editions were really the same with different plates, titles, and preliminary matter. But they are really different. The spacing of the words, letters and lines is different throughout, and there are different misprints. The watermarks of the paper also differ.

IV. (**The Berlin "facsimile" Folio of 1892.**) This is a photozincograph reproduction of the London folio of 1600. It lacks the ink emendations on pages 11, 22, 47, &c., found in the original, and is wanting also in some of the asterisks in the margins.

V. (**The American translation of 1893.**) Frontispiece portrait || p. i. title WILLIAM GILBERT | OF COLCHESTER, | physician of London, | on the | Loadstone and Magnetic Bodies, | and on | the great magnet the earth. | A new Physiology, | demonstrated with many arguments and experiments. | A translation by | P. Fleury Mottelay, | . . . | New York: | John Wiley & Sons, | 53 East Tenth Street | 1893. || p. ii bears imprint of Ferris Bros. *Printers*, 326 Pearl Street, New York. || p. iii. reduced reproduction of title of 1600 edition || verso the Gilbert arms || p. v. Translator's Preface || p. ix. Biographical Memoir || p. xxxi. Contents || p. xxxvii. Address of Edward Wright || p. xlvii. Author's Preface. || p. liii. Explanation of some terms. || pp. 1-358 text of the work. || p. 359 reduced reproduction of title of 1628 edition. || p. 360 *ditto* of 1633 edition. || p. 361 *ditto* of Gilbert's *De Mundo Nostro* of 1651. || pp. 363 to 368 General Index. || Pages xxx, xlvi, lii, and 362 are blanks. There are no signatures. Octavo. Diagrams reduced from woodcuts of the folio of 1600. Some copies bear on title the imprint | London: | Bernard Quaritch, | 15 Piccadilly. ||



NOTES ON THE *DE MAGNETE* OF DR. WILLIAM GILBERT.



URING the work of revising and editing the English translation of *De Magnete*, many points came up for discussion, requiring critical consideration, and the examination of the writings of contemporary or earlier authorities. Discrepancies between the texts of the three known editions—the London folio of 1600, and the two Stettin quartos of 1628 and 1633 respectively—demanded investigation. Passages relating to astrology, to pharmacy, to alchemy, to geography, and to navigation, required to be referred to persons acquainted with the early literature of those branches. Phrases of non-classical Latin, presenting some obscurity, needed explanation by scholars of mediæval writings. Descriptions of magnetical experiments needed to be interpreted by persons whose knowledge of magnetism enabled them to infer the correct meaning to be assigned to the words in the text. In this wise a large amount of miscellaneous criticism has been brought to bear, and forms the basis for the following notes. To make them available to all students of Gilbert, the references are given to page and line both of the Latin folio of 1600 and of the English edition of 1900. S. P. T.

THE GLOSSARY:

Gilbert's glossary is practically an apology for the introduction into the Latin language of certain new words, such as the nouns *terrella*, *versorium*, and *verticitas*, and the adjectival noun *magneticum*, which either did not exist in classical Latin or had not the technical meaning which he now assigns to them. His *terrella*, or *μικρόγη*, as he explains in detail on p. 13, is a little magnetic model of the earth, but in the glossary he simply defines it as *magnes globosus*. Neither *terrella* nor *versorium* appears in any Latin dictionary. No older writer had used either word, though Peter Peregrinus (*De Magnete*, Augsburg, 1558) had described experiments with globular loadstones, and pivotted magnetic needles suitable for use in a compass had been known for nearly three centuries. Yet the pivotted needle was not denominated *versorium*. Blondo (*De Ventis*, Venice, 1546) does not use the term. Norman (*The Newe Attractione*, London, 1581) speaks of the "needle or compasse," and of the "wyre." Barlowe (*The Navigators Supply*, London, 1597) speaks of

The term *orbis virtutis*, defined by Gilbert in the glossary, and illustrated by the cuts on pages 76, 77, and 96, might be effectively translated by *sphere of influence*, or *orbit within which there is sensible attraction*. It has been preferred, however, to translate it literally as the *orbe of virtue*, or *orbe of magnetick virtue*. This choice has been determined by the desire to adopt such an English phrase as Gilbert would himself have used had he been writing English. T. Hood, writing in 1592 in his book *The Use of both the Globes*, in using the word *orbe*, says that the word *globe* signifies a solid body, while a *sphere* is hollow, like two "dishes joyned by the brimme"; "The Latines properly call *Orbis* an *Orbe*"; "Moreouer the word *Sphaera* signifieth that instrument made of brasen hoopes (wee call it commonly a ringed Sphere) wherewith the Astronomers deliuer unto the nouices of that Science the vnderstanding of things which they imagine in the heauen." Further, Dr. Marke Ridley in his *Treatise of Magneticall Bodies and Motions* (1613), has a chapter (XIII) "Of the distance and Orbe of the Magnets vertue," throughout which the term *Orbe* is retained. Sir Thomas Browne also writes of "the orb of their activities."

The word *Coitio*, used by Gilbert for the mutual force between magnet and iron, has been retained in its English form, *coition*. Gilbert evidently adopted this term after much thought. The Newtonian conception of action and reaction being necessarily equal had not dawned upon the mediæval philosophers. The term *attraction* had been used in a limited sense to connote an action in which a force was conceived of as being exerted on one side only. Diogenes of Apollonia, Alexander Aphrodiseus, Democritus, and others, conceived the magnet to draw at the iron without the iron in any way contributing to that action. Saint Basil specially affirms that the magnet is not drawn by iron. On the other hand, Albertus Magnus had conceived the idea that the iron sought the magnet by a one-sided effort in which the magnet took no part. Gilbert had the wit to discern that the action was mutual, and to mark the new conception he adopted the new term, and defined it as it stands in his glossary. It is "a concourse or concordancy of both," and to emphasize his meaning he adds, "not as if there were an *ἐλκτική δύναμις*, but a *συνδρομή*"—not a tractile power, but a running together. The adjective *ἐλκτική* is obviously related to the verb *ἐλκω*, I draw: but its meaning puzzled the subsequent editors of the text, for in the two Stettin editions of 1628 and 1633, the phrase appears in the respective forms of *ἐλητική δύναμις* and *ἐλκυστική δύναμις*. In Creech's English version of Lucretius (edition of 1722, p. 72a, in the footnote) is the commentary "Galen, disputing against Epicurus, uses the term *ἐλκεῖν*, which seems likewise too violent." It may be noted that the same verb occurs in the passage from the *Io* of Plato quoted below. The term *συνδρομή* applied by Gilbert to explain his term *Coitio* is used by Diodorus for the mutual onset of two hostile forces.

A picturesque sentence from Sir Thomas Browne's *Pseudodoxia Epidemica* (London, 1650, p. 51) sets the matter succinctly forth. "If in two skiffs of cork, a Loadstone and Steel be placed within the orb of their activities, the one doth not move the other standing still, but both hoist sayle and steer unto each other; so that if the Loadstone attract, the Steel hath also its attraction; for in this action the Alliency is reciprocally, which jointly felt, they mutually approach and run into each others arms."

The page and line references given in these notes are in all cases first to the Latin edition of 1600, and secondly to the English edition of 1900.

Page 1, line 28. Page 1, line 28. *Plato in Ione*.—The passage in the *Io* of Plato is in chap. v. Socrates addressing the poet *Io* tells him that his facility in reciting Homer is not really an art: *θεία δὲ δύναμις, ἣ σε κινεῖ ὥσπερ ἐν τῇ λίθῳ, ἣν Εὐριπίδης μὲν Μαγνήτιν ὠνόμασεν, οἱ δὲ πολλοὶ Ἡράκλειαν. καὶ γὰρ αὕτη ἡ λίθος οὐ μόνον αὐτοὺς τοὺς δακτυλίους ἄγει τοὺς σιδηροῦς, ἀλλὰ καὶ δύναμιν ἐντίθησι τοῖς δακτυλίοις, ὥστ' αὖ δύνασθαι τὰντὸν τοῦτο ποιεῖν, ὅπερ ἡ λίθος, ἄλλους ἄγειν δακτυλίους, ὥστ' ἐνίοθ' ὀρμαθὸς μακρὸς πᾶν σιδηρίων καὶ δακτυλίων ἐξ ἀλλήλων ἤρτηται· πᾶσι δὲ τούτοις ἐξ ἐκείνης τῆς λίθου ἡ δύναμις ἀνήρτηται.* The idea is that as the loadstone in attracting an iron ring will make it into a magnet, which can in turn act magnetically on another ring, and this on yet another, so the inspiration of the Muse is transferred to the poet, who in turn hands on the inspiration through the reciter to the listener. After further expanding the same idea of the transference of influence, Socrates again mentions the magnet (chap. vii.): *Οἷσθ' οὖν ὅτι οὗτός ἐστιν ὁ θεατῆς τῶν δακτυλίων ὁ ἔσχατος, ὃν ἐγὼ ἔλεγον ὑπὸ τῆς Ἡρακλειώτιδος λίθου ἀπ' ἀλλήλων τὴν δύναμιν λαμβάνειν, ὁ δὲ μέσος σὺν ὁ ῥαψῳδὸς καὶ ὑποκριτής, ὁ δὲ πρῶτος αὐτός ὁ ποιητής; ὁ δὲ θεὸς διὰ πάντων τούτων ἔλκει τὴν ψυχὴν ὅποι ἂν βούληται τῶν ἀνθρώπων, κ.τ.λ.* (Edition Didot of 1856, vol. i., p. 391; or Stephanus, p. 533 D).

There is another reference in Plato to the magnet, namely, in the *Timæus* (p. 240, vol. ii., Edit. citat.). See the Note to p. 61.

The reference by Euripides to the magnet occurs in the lost play of *Œneus*, in a fragment preserved by Suidas. See *Fragmenta Euripidis* (Ed. Didot, 1846, p. 757, or Nauck's edition, No. 567).

ὡς Εὐριπίδης ἐν Οἰνεί· τὰς βροτῶν γνώμας σκοπῶν, ὥστε Μαγνήτις λίθος τὴν δόξαν ἔλκει καὶ μεθίστησιν πάλιν.

Page 1, line 28. Page 1, line 29. The brief passage from Aristotle's *De Anima* referring to Thales is quoted by Gilbert himself at the bottom of p. 11.

Page 2, line 1. Page 1, line 29. The edition of 1628 inserts commas between Theophrastus and Lesbios, and between Julius and Solinus, as though these were four persons instead of two.

Page 2, line 8. Page 2, line 5. *si allio magnes illitus fuerit, aut si adamas fuerit.* An excellent version of this myth is to be found in Julius Solinus, *Polyhistor, De Memorabilibus*, chap. lxiv., of which the English version of 1587, by A. Golding, runs thus: "The Diamonde will not suffer the Lodestone to drawe yron unto him: or if y^e Lodestone haue alreadie drawne a peece of yron to it, the Diamond snatcheth and pulleth away as hys bootye whatsoever the Lodestone hath taken hold of." Saint Augustine repeats the diamond myth in his *De Civitate Dei*, lib. xxi. Baptista Porta says (p. 211 of the English version of 1658): "It is a common Opinion amongst Sea-men, That Onyons and Garlick are at odds with the Loadstone: and Steers-men, and such as tend the Mariners Card are forbid to eat Onyons or Garlick, lest they make the Index of the Poles drunk. But when I tried all these things, I found them to be false: for not onely breathing and belching upon the Loadstone after eating of Garlick, did not stop its vertues: but when it was all anoynted over with the juice of Garlick, it did perform its office as well as if it had never been touched with it: and I could observe almost not the least difference, lest I should make void the endeavours of the Ancients."

And again, When I enquired of Marines, whether it were so, that they were forbid to eat Onyons and Garlick for that reason; they said, They were old Wives fables, and things ridiculous; and that Sea-men would sooner lose their lives, then abstain from eating Onyons and Garlick."

The fables respecting the antipathy of garlick and of the diamond to the operation of the magnet, although already discredited by Ruellius and by Porta, died hard. In spite of the exposure and denunciations of Gilbert—compare p. 32—these tales were oft repeated during the succeeding century. In the appendix to Sir Hugh Plat's *Jewel House of Art and Nature*, in the edition of 1653, by D. B. Gent, it is stated there (p. 218): "The Loadstone which . . . hath an admirable vertue not onely to draw Iron to it self, but also to make any Iron upon which it is rubbed to draw iron also, it is written notwithstanding, that being rubbed with the juyce of Garlick, it loseth that vertue, and cannot then draw iron, as likewise if a Diamond be layed close unto it."

Pliny wrote of the alleged antipathy between diamond and goat's blood. The passage as quoted from the English version of Pliny's *Natural Historie of the World*, translated by Philemon Holland (London, 1601, p. 610, chap. iv.), runs: "But I would gladly know whose invention this might be to soake the Diamond in Goats blood, whose head devised it first, or rather by what chance was it found out and knowne? What conjecture should lead a man to make an experiment of such a singular and admirable secret, especially in a goat, the filthiest beast . . . in the whole world? Certes I must ascribe both this invention and all such like to the might and beneficence together of the divine powers: neither are we to argue and reason how and why Nature hath done this or that? Sufficient is it that her will was so, and thus she would have it."

Page 2, line 22. Page 2, line 22. *Machometis sacellum*. Gilbert credits Matthiolus (the well-known herbalist and commentator on Dioscorides) with producing the fable as to Mahomet's coffin being suspended in the air by a magnet. Sir Richard Burton, in his famous pilgrimage to El Medinah in 1855, effectually disposed of this myth. The reputed sarcophagus rests simply on bricks on the floor. But it had long been known that aerial suspension, even of the lightest iron object, in the air, without contact above or below, was impossible by any magnetic agency.

In Barlowe's *Magneticall Aduertisements* (London, 1616, p. 45) is the following: "As for the Turkes Mahomet, hanging in the ayer with his yron cheft it is a most grosse vntruth, and vtterly impossible it is for any thing to hange in the ayer by any *magneticall* power, but that either it must touch the stone it selfe, or else some intermediate body, that hindreth it from comming to the stone (like as before I haue shewed) or else some stay below to keepe it from ascending, as some small wier that may scantly bee seene or perceiued."

Page 2, line 26. Page 2, line 26. *Arsinoes templum*.—The account in Pliny of the magnetic suspension of the statue of Arsinoe in the temple built by Chinocrates is given as follows in the English version (London, 1601) of Philemon Holland (p. 515): "And here I cannot chuse but acquaint you with the singular invention of that great architect and master deviser, of Alexandria in Ægypt *Dinocrates*, who began to make the arched rouse of the temple of *Arsinoe* all of Magnet or this Loadstone, to the end, that within that temple the statue of the said princeffe made of yron, might seeme to hang in the aire by nothing. But prevented he was by death

before hee could finish his worke, like as king *Ptolomæ* also, who ordained that temple to be built in the honour of the said *Arfinoe* his sister."

There are a number of simlar myths in Aufonius, Claudian, and Cassiodorus, and in the writings of later ecclesiastical historians, such as Rufinus and Prosper Aquitanus. The very meagre accounts they have left, and the scattered references to the reputed magical powers of the loadstone, suggest that there existed amongst the primitive religions of mankind a *magnet-worship*, of which these records are traces.

Page 2, line 37. Page 2, line 41. *Brafevolus* [or *Brasavola*].—The list of authorities here cited consists mostly of well-known mediæval writers on *materia medica* or on minerals: the last on the list, *Hannibal Rosetius Calaber*, has not been identified.

The following are the references in the order named by Gilbert :

Antonio Musa Brasavola. *Examen omnium simplicium medicamentorum*, Section 447 (Lugdun., 1537).

Joannes Baptista Montanus. *Metaphrasis summaria eorum quæ ad medicamentorum doctrinâ attinet* (Augustæ Reticæ, 1551).

Amatus Lusitanus. *Amati Lusitani in Dioscoridis Anazarbei de materia medica libros quinque* (Venet., 1557, p. 507).

Oribasius. *Oribasii Sardiani ad Eunapium libri 4 quibus . . . facultates simplicium . . . continentur* (Venet., 1558).

Aetius Amidenus. *Aetii Amideni Librorum medicinalium . . . libri octo nunc primum in lucem editi* (Greek text, Aldine edition, Venet., 1534). A Latin edition appeared in Basel, 1535. See also his *tetrabiblos ex veteribus medicinæ* (Basil., 1542).

Avicenna (Ibn Sinâ). *Canona Medicinæ* (Venice, 1486), liber ii., cap. 474.

Serapio Mauritanus (Yuhannâ Ibn Sarapion). In hoc volumine continentur . . . *Ioan. Sarapionis Arabis de Simplicibus Medicinis opus præclarum et ingens . . .* (edited by Brunfels, Argentorati, 1531, p. 260).

Hali Abbas ('Alî Ibn Al 'Abbâs). *Liber totius medicinæ necessaria cõtineans . . . quem Haly filius Abbas edidit . . . et a Stephano ex arabica lingua reductus* (Lugd., 1523, p. 176 verso).

Santes de Ardoniis (or Ardoynis). *Incipit liber de venenis quem magister santes de ardoynis . . . edere cepit venetiis die octauo nouëbris*, 1424 (Venet., 1492).

Petrus Apponenfis (or Petrus de Abano). The loadstone is referred to in two works by this author.

(1) *Conciliator differentiarum philosophorum: et precipue medicorum clarissimi viri Petri de Abano Patauini feliciter incipit* (Venet., 1496, p. 72, verso, Quæstio LI.).

(2) *Tractatus de Venenis* (Roma, 1490, cap. xi.).

Marcellus (called Marcellus Empiricus). *De Medicamentis*, in the volume *Medici antiqui omnes* (Venet., 1547, p. 89).

Arnaldus (Arnaldus de Villa Nova). *Incipit Tractatus de virtutibus herbarum* (Venet., 1499). See also *Arnaldi Villanovani Opera omnia* (Basil., 1585).

Marbodeus Gallus. *Marbodei Galli poetæ vetustissimi de lapidibus pretiosis Enchiridion* (Friburgi, 1530 [1531], p. 41).

Albertus Magnus. *De Mineralibus et rebus metallicis* (Venet., 1542, lib. ii., de lapidibus preciosis, p. 192). There is a reference to the loadstone

also in a work attributed falsely to Albertus, but now ascribed to Henricus de Saxonia, *De virtutibus herbarum, de virtutibus lapidum*, etc. (Rouen, 1500, and subsequent editions). An English version, *The Secrets of Albertus Magnus of the vertues of hearbs stones and certaine beafts* was publisht in London in 1617.

Matthæus Silvaticus. *Pandectæ Medicinæ* (Lugduni, 1541, cap. 446).

Hermolaus Barbarus. His work, *Hermolai Barbari Patritii Veneti et Aquileiensis patriarchæ Corollarii Libri quinque* . . . Venet., 1516, is an early herbal. On p. 103 are to be found descriptions of *lapis gagatis* and *lapis magnes*. The latter is mostly taken from Pliny, and mentions the alleged theamedes, and the myth of the floating statue.

Camillus Leonardus. *Speculum Lapidum* (Venet., 1502, fol. xxxviii.). An English translation, *The Mirror of Stones*, appeared in London in 1750.

Cornelius Agrippa. *Henrici Cor. Agrippæ ab Netteſbeym* . . . *De Occulta Philosophia Libri Tres* (Antv., 1531). The English version *Of the Vanitie and uncertaintie of Artes* was publisht in London, 1569, and again later.

Fallopilus (Gabriellus). *G. F. de simplicibus medicamentis purgantibus tractatus* (Venet., 1566). See also his *Tractatus de compositione medicamentorum* (Venet., 1570).

Johannes Langius. *Epistolarum medicinalium volumen tripartitum* (Paris, 1589, p. 792).

Cardinalis Cufanus (Nicolas Khrypffs, Cardinal de Cufa). *Nicolai Cufani de staticis experimentis dialogus* (Argentorati, 1550). The English edition, entitled *The Idiot in four books*, is dated London, 1650.

Page 3, line 1. Page 2, line 42. *Marcellus*.—"Marcellus Empiricus, médecin de Théodose-le-Grand, dit que l'aimant, appelé *antiphyſon*, attire et repouſſe le fer." (Klaproth, *Sur l'invention de la bouſſole*, 1834, p. 12.) The passage from Marcellus runs: "Magnetes lapis, qui antiphyſon dicitur, qui ferrum trahit et abjicit, et magnetes lapis qui sanguinem emittit et ferrum ad se trahit, collo alligati aut circa caput dolori capitis medentur." (Marcellus, *de Medicamentis*: in the volume *Medici antiqui omnes, qui latinis literis morborum genera persecuti sunt*. Venet., 1547, p. 89.)

Page 3, line 11. Page 3, line 9. *Thomas Erastus*.—The work in question is *Disputationum de Medicina nova Philippi Paracelsi, Pars Prima: in qua quæ de remediis superstitiosis & Magicis curationibus ille prodidit, præcipuè examinantur à Thoma Erasto in Schola Heydebergensi, professore*. (Basilæ, 1572. Parts 2 and 3 appeared the same year, and Part 4 in 1573.)

Gilbert had no more love for Paracelsus than for Albertus Magnus or others of the magic-mongers. Indeed the few passages in Paracelsus on the magnet are sorry stuff. They will mostly be found in the seventh volume of his collected works (*Opera omnia*, Frankfurt, 1603). A sample may be taken from the English work publisht in London, 1650, with the title: *Of the Nature of Things, Nine Books; written by Philipp Theophrastus of Hohenheim, called Paracelsus*.

"For any Loadstone that Mercury hath but touched, or which hath been smeered with Mercuriall oyle, or only put into Mercury will never draw Iron more" (p. 23).

"The life of the Loadstone is the spirit of Iron; which may bee extracted, and taken away with spirit of Wine" (p. 32).

Page 3, line 13. Page 3, line 11. *Encelius* (or *Entzelt*, Christoph)

wrote a work published in 1551 at Frankfurt, with the title *De re metallica, hoc est, de origine, varietate, et natura corporum metallicorum, lapidum, gemmarum, atque aliarum quæ ex fodinis eruuntur, rerum, ad medicinæ usum deservientium, libri iii.* This is written in a singular medley of Latin and German. Gilbert undoubtedly took from it many of his ideas about the properties of metals. See the note to p. 27 on *plumbum album*.

Page 3, line 20. Page 3, line 21. *Thomas Aquinas*.—The reference is to his commentaries upon the *Physica* of Aristotle. The passage will be found on p. 96 *bis* of the Giunta edition (Venet., 1539). The essential part is quoted by Gilbert himself on p. 64.

Page 3, line 39. Page 3, line 45. *pyxidem*.—The word *pyxis*, which occurs here, and in the next sentence as *pyxidem nauticam*, is translated *compass*. Eleven lines lower occurs the term *nautica pyxidula*. This latter word, literally the “little compass,” certainly refers to the portable compass used at sea. Compare several passages in Book IV. where a contrasting use is made of these terms; for example, on pp. 177 and 202. Calcagninus, *De re nautica*, uses the term *pyxidecula* for an instrument which he describes as “vitro intacta.” On p. 152, line 9, Gilbert uses the non-classical noun *compassus*, “boreale lilium compassi (quod Boream respicit),” and again on p. 178, line 3.

Page 4, line 2. Page 4, line 2. *Melphitani*.—The inhabitants of Amalfi in the kingdom of Naples. The claim of the discovery or invention of the mariners’ compass in the year 1302 by one Joannes Goia, or Gioia, also named as Flavio Goia, has been much disputed. In Guthrie’s *New System of Modern Geography* (London, 1792, p. 1036), in the Chronology, is set down for the year 1302:

“The mariner’s compass invented, or improved by Givia, of Naples. The flower de luce, the arms of the Duke of Anjou, then King of Naples, was placed by him at the point of the needle, in compliment to that prince.”

In 1808 an elaborate treatise was printed at Naples, by Flaminio Venanson with the title, *De l’invention de la Bouffole Nautique*. Venanson, who cites many authorities, endeavours to prove that if Gioia did not discover magnetic polarity he at least invented the compass, that is to say, he pivotted the magnetic needle and placed it in a box, with a card affixed above it divided into sixteen parts bearing the names of the sixteen principal winds. He alleges in proof that the compass-card is emblazoned in the armorial bearings of the city of Amalfi. This view was combatted in the famous letter of Klaproth to Humboldt published in Paris in 1834. He shows that the use of the magnetized needle was known in Europe toward the end of the twelfth century; that the Chinese knew of it and used it for finding the way on land still earlier; that there is no compass-card in the arms of the city of Amalfi; but he concedes that Gioia may have improved the compass in 1302 by adding the wind-rose card. The most recent contributions to the question are a pamphlet by Signorelli, *Sull’ invenzione della Buffola nautica, ragionamento di Pietro Napoli Signorelli, segretario perpetuo della Società Pontaniana; letto nella seduta del 30 settembre 1860*; Matteo Camera’s *Memorie Storico-diplomatiche dell’ antica città e ducato di Amalfi* (Salerno, 1876); and Admiral Luigi Fincati’s work *Il Magnete, la Calamita, e la Buffola* (Roma, 1878). An older mention of Gioia is to be found in Blundevile’s *Exercises* (3rd edition, 1606, pp. 257-258). See also Crescentio della Nautica Mediterranea, (Roma, 1607, p. 253), and Azuni, *Differtazione sull’ origine della buffola nautica* (Venezia, 1797).

There appears to be a slip in Gilbert's reference to Andrea Doria, as he has confounded the town of Amalfi in Principato Citra with Melfi in Basilicata.

One of the sources relied upon by historians for ascribing this origin of the compass is the *Compendio dell' Istoria del Regno di Napoli*, of Collenuccio (Venet., MDXCI.), p. 5.

"Nè in questo tacerò Amalfi, picciola terra, & capo della costa di Picentia, alla quale tutti quelli, che'l mar caualcano, vfficiofamente eterno gratie debono referire, effendo prima in quella terra trovato l'vfo, & l'artificio della calamita, & del buffolo, col quale i nauiganti, la ftella Tramontana infallibilmente mirando, direzzano il lor corfo, fi come è publica fama, & gli Amalfitani fi gloriano, nè senza ragione dalli piu fi crede, effendo cofa certa, che gli antichi tale inftrumento non hebbero; nè effendo mai in tutto falfo quello, che in molto tempo è da molti fi diuolga."

Another account is to be found in the *Historiarum fui temporis*, etc., of Paulus Jovius (Florent., 1552), tom. ii., cap. 25, p. 42.

"Quum effem apud Philippum superuenit Ioachinus Leuantius Ligur a Lotrechio miffus, qui deposceret captiuos; fed ille negauit fe daturum, quando eos ad ipfum Andream Auriam ammirantem deducendos effe iudicaret. Vgonis uerò cadauer, ut illudentium Barbarorum contumeliis eriperetur, ad Amalphim urbem delatum eft, in ædeque Andreæ apostoli, tumultuariis exequis tumulatum. In hac urbe citriorum & medicorum odoratis nemoribus æquè peramœna & celebri, Magnetis ufum nauigantibus hodie familiarem & neceffarium, adinuentum fuiffe incolæ afferunt."

Flavius Blondus, whom Gilbert cites, gives the following reference, in which Gioia's name is not mentioned, in the section upon Campania Felix of his Italy (*Blondi Flavii Forlinensis . . . Italia Illustrata*, Basilæ, 1531, p. 420).

"Sed fama est qua Amalphitanos audiuius gloriari, magnetis ufum, cuius adminiculo nauigantes ad arcton diriguntur, Amalphi fuiffe inuentum, quicquid uero habeat in ea re ueritas, certū est id noctu nauigandi auxilium prifcis omnino fuiffe incognitum."

There is a further reference to the alleged Amalphian in Caelius Calcagninus *De re nautica commentatio*. (See *Thesaurus Græcarum Antiquitatum*, 1697, vol. xi., p. 761.) On the other hand Baptista Porta, who wrote in Naples in 1558 (*Magia Naturalis*) distinctly fets aside the claim as baseless.

William Barlowe, in *The Navigators Supply* (1597, p. A3), fays: "Who was the first inuentor of this Instrument miraculous, and endued, as it were, with life, can hardly be found. The lame tale of one *Flavius* at *Amelphis*, in the kingdome of *Naples*, for to haue deuifed it, is of very slender probabilitie. *Pandolph Collenutius* writing the Neapolitane historie telleth vs, that they of *Amelphis* fay, it is a common opinion there, that it was first found out among them. But *Polidore Virgil*, who fearched most diligently for the Inuentors of things, could neuer heare of this opinion (yet himfelfe being an Italian) and as he confeffeth in the later ende of his third booke *de inventoribus rerum*, could neuer vnderstand anything concerning the first inuention of this instrument."

According to Park Benjamin (*Intellectual Rise in Electricity*, p. 146) the use of the pivotted compass arose and spread not from Amalfi at the hands of Italians in the fourteenth century, but from Wisbuy, at the hands of the Finns, in the middle of the twelfth century.

Hakewill (*An Apologie or Declaration of the Power and Providence of God*, London, 1673, pp. 284-285) says:

"But *Blondus*, who is therein followed by *Pancirollus*, both *Italians*, will not haue *Italy* loofe the praife thereof, telling vs that about 300 yeares agoe it was found out at Malphis or Melphis, a Citty in the Kingdome of *Naples* in the *Province* of *Campania*, now called *Terra di Lovorador*. But for the Author of it, the one names him not, and the other assures vs, he is not knowne: yet *Salmuth* out of *Ciezus* & *Gomara* confidently christens him with the name of *Flavius*, and so doth *Du Bartas* in those excellent verses of his touching this subject.

"W' are not to *Ceres* so much bound for bread,
Neither to *Bacchus* for his clusters red,
As Signior *Flavio* to thy witty tryall,
For first inventing of the Sea-mans dyall,
Th' vse of the needle turning in the same,
Divine device, O admirable frame !"

"It may well be then that *Flavius* the *Melvitan* was the first inventor of guiding the ship by the turning of the needle to the *North*: but some *German* afterwards added to the *Compass* the 32 points of the winde in his owne language, whence other Nations haue since borrowed it."

Page 4, line 14. Page 4, line 14. *Paulum Venetum*.—The reference is to Marco Polo. He returned in 1295 from his famous voyage to Cathay. But the oft-repeated tale that he first introduced the knowledge of the compass into Europe on his return is disposed of by several well-established facts. Klaproth (*op. citat.*, p. 57) adduces a mention of its use in 1240 in the Eastern Mediterranean, recorded in a work written in 1242 by Bailak of Kibdjak. And the passages in the Iceland Chronicle, and in Alexander of Neckham are still earlier.

Page 4, line 17. Page 4, line 17. *Goropius*. See *Hispanica Ioannis Goropii Becani* (Plantin edition, Antv., 1580), p. 29. This is a discussion of the etymologies of the names of the points of the compass: but is quite unauthoritative.

Page 4, line 23. Page 4, line 26. *Parvaim*.—Respecting this reference, Sir Philip Magnus has kindly furnished the following note. A clue to the meaning of *Parvaim*, which should be written in English letters with a *v*, not a *u*, will be found in 2 *Chronicles*, iii. 6. In the verse quoted the author speaks of gold as the gold of Parvaim, *וְהַנְּהָב זָהָב פְּרָוַיִם*, and *פְּרָוַיִם* Parvaim is taken as a gold-producing region. It is regarded by some as the same as Ophir. The word is supposed to be cognate with a Sanskrit word *pūrva* signifying "prior, anterior, oriental." There is nothing in the root indicating gold. A form similar to Parvaim, and also a proper name, is Sepharvaim, found in 2 *Kings*, xix. 13, and in *Isaiah*, xxxvii. 13, and supposed to be the name of a city in Assyria.

Page 4, line 35. Page 4, line 41. Cabot's observation of the variation of the compass is narrated in the *Geografia* of Livio Sanuto (Vinegia, 1588, lib. i., fol. 2). See also Fournier's *Hydrographie*, lib. xi., cap. 10.

Page 4, line 36. Page 4, line 42. *Gonzalus Oviedus*.—The reference is to Gonzalo Fernandez de Oviedo y Valdès. *Summario de la Historia general y natural de las Indias occidentales*, 1525, p. 48, where the author speaks of the crossing of "la linea del Diametro, donde las Agujas hacen la

diferencia del Nordestear, ò Noroesteear, que es el parage de las Islas de los Açores."

Page 5, line 8. Page 5, line 11. *Petri cujusdam Peregrini*.—This opusculum is the famous letter of Peter Peregrinus written in 1269, of which some twenty manuscript copies exist in various libraries in Oxford, Rome, Paris, etc., and of which the oldest printed edition is that of 1558 (Augsburg). See also Libri, *Histoire des Sciences Mathématiques* (1838); Bertelli in Boncompagni's *Bull. d. Bibliogr.* T. I. and T. IV. (1868 and 1871), and Hellmann's *Rara Magnetica* (1898). A summary of the contents of Peregrinus's book will be found in Park Benjamin's *Intellectual Rise in Electricity* (1895), pp. 164-185.

Page 5, line 12. Page 5, line 15. *Johannes Taisner Hannonius*.—Taisnier, or Taysnier, of Hainault, was a plagiarist who took most of the treatise of Peregrinus and published it in his *Opusculum . . . de Natura Magnetis* (Coloniæ, 1562), of which an English translation by Richard Eden was printed by R. Jugge in 1579.

Page 5, line 18. Page 5, line 23. *Collegium Conimbricense*.—This is a reference to the commentaries on Aristotle by the Jesuits of Coimbra. The work is *Colegio de Coimbra da Companhia de Jesu, Cursus Conimbricensis in Octo libros Physicorum* (Coloniæ, sumptibus Lazari Ratzneri, 1599). Other editions: Lugd. 1594; and Colon., 1596. The later edition of 1609, in the British Museum, has the title *Commentariorum Collegii Conimbricensis in octo libros physicorum*.

Page 5, line 25. Page 5, line 31. *Martinus Cortesius*.—His *Arte de Navegar* (Sevilla, 1556) went through various editions in Spanish, Italian, and English. Eden's translation was published 1561, and again in 1609.

Page 5, line 26. Page 5, line 33. *Bessardus*.—Toussaincte de Bessard wrote a treatise, *Dialogue de la Longitude* (Rouen, 1574), which gives some useful notes of nautical practice, and of the French construction of the compass. Speaking of the needle he says: "Elle ne tire pas au pole du monde: ains regarde, au Pole du Zodiaque, comme il fera discoursu, cy apres" (p. 34). On p. 50 he speaks of "l'aiguille Aymantine." On p. 108 he refers to Mercator's *Carte Générale*, and denies the existence of the alleged loadstone rock. On p. 15 he gives the most naïve etymologies for the terms used: thus he assigns as the derivation of *Sud* the Latin *judo*, because the south is hot, and as that of *Ouest* that it comes from *Ou* and *Est*. "Comme, qui diroit, Ou est-il? à scavoir le Soleil, qui estoit nagueres sur la terre."

Page 5, line 28. Page 5, line 35. *Jacobus Severtius*.—Jacques Severt, whose work, *De Orbis Catoptrici seu mapparum mundi principiis descriptione ac usu libri tres* (Paris, 1598), would have probably lapsed into obscurity, but being just newly published was mentioned by Gilbert for its follies.

Page 5, line 30. Page 5, line 38. *Robertus Norman*.—Author of the rare volume *The Newe Attraetive*, published in London, 1581, and several times reprinted. This work contains an account of Norman's discovery of the Dip of the magnetic needle, and of his investigation of it by means of the Dipping-needle, which he invented. He was a compassmaker of the port of London, and lived at Limehouse.

Page 5, line 32. Page 5, line 40. *Franciscus Maurolycus*.—The work to which the myth of the magnetic mountains is thus credited is, *D. Francisci Abbatis Messanensis Opuscula Mathematica*, etc. (Venet., MDLXXV, p. 122a). "Sed cur sagitta, vel obelus à vero Septentrione, quandoque ad dextram,

quandoque ad sinistram declinat? An quia sagitta, sicut magnes (cuius est simia) non verum Septentrionem, sed insulam quandam (quam Olaus Magnus Gothus in sua geographia vocat insulam magnetum) semper ex natura inspicere cogitur?"

Page 5, line 35. Page 5, line 43. *Olaus Magnus*.—The famous Archbishop of Upsala, who wrote the history of the northern nations (*Historia de Gentibus Septentrionalibus*), of which the best edition, illustrated with many woodcuts, appeared in Rome in 1555. An English edition entitled *A Compendious History of the Goths, Swedes, and Vandals, and Other Northern Nations* was printed in London in 1658; but it is much abbreviated and has none of the quaint woodcuts. The reference on p. 5 appears to be to the following passage on p. 409 (ed. 1555). "Demum in suppolariibus insulis magnetum montes reperiuntur, quorum fragmentis ligna fagina certo tempore applicata, in faxeam duritiem, et vim attractivam convertuntur," or the following on p. 89: "Magnetes enim in extremo Septentrionis veluti montes, unde nautica directio constat, reperiuntur: quorum etiam magnetum tam vehemens est operatio, ut certis lignis fagineis conjuncti, ea vertunt in sui duritiem, & naturam attractivam." On p. 343 is a woodcut depicting the penalties inflicted by the naval laws upon any one who should maliciously tamper with the compass or the loadstone, "qui malitiosè nauticum gnomonem, aut compassum, & præcipuè portionem magnetis, unde omnium directio dependet, falsaverit." He was to be pinned to the mast by a dagger thrust through his hand. It will be noted that the ships carried both a compass, and a piece of loadstone wherewith to stroke the needle.

There is in the Basel edition of this work, 1567, a note *ad lectorem*, on the margin of Carta 16a, as follows:

"Insula 30 milliarium in longitud. & latitud. Polo arctico subjecta.

"Ultra quam directorium nauticum bossolo dicū uires amittit: propterea quòd illa insula plena est magnetum."

This myth of the magnetic mountains, probably originating with Nicander, appears, possibly from an independent source, in the East, in China, and in the tales of the Arabian Nights.

Ptolemy gives the following account in his *Geographia* (lib. vii., cap. 2):

Φέρονται δὲ καὶ ἄλλαι συνεχεῖς δέκα νῆσοι καλούμεναι Μανίολαι ἐν αἷς φάσι τὰ σιδήρους ἔχοντα ἥλους πλοῖα κατέχεσθαι, μήποτε τῆς Ἡρακλείας λίθου περὶ αὐτὰς γενομένης, καὶ διὰ τοῦτο ἐπιούροις ναυπηγεῖσθαι. Some editions omit the name of the Manioles from the passage.

No two authorities agree as to the place of these alleged magnetic mountains. Some place them in the Red Sea. Fracastorio, *De Sympathia et Antipathia*, cap. 7 (*Opera omnia*, Giunta edition, 1574, p. 63), gives the following reason for the variation of the compass:

"Nos igitur diligentius rem considerātes dicimus causam, quæ perpendiculum illud ad polum vertatur, esse montes ferri, & magnetis, qui sub polo sunt, ut negotiatores affirmant, quorum species per incredibilem distantiam usque ad maria nostra propagata ad perpendiculum usque, ubi est magnes, consuetam attractionem facit: propter distantiam autem quum debilis sit, non moueret quidem magnetem, nisi esset in perpendiculari: quare & si non trahit usque ad principium, unde effluxit, at mouet tamē, & propinquiorem facit, quo potest. Quod si naues sorte vllæ propinquiores sint illis montibus, ferrum omne earū euellitur, propter quod nauigijs incolæ vtuntur clauis ligneis astrictis."

In the last chapter of his *De Sympathia*, Fracastorio returns to the subject

in consequence of some doubts expressed by Giambattista Rhamnusio, seeing that the loadstones in the Island of Elba do not sensibly deflect the magnet. Fracastorio replies thus (p. 76, *op. citat.*):

“Primum igitur vtrum sub Polo sint. Magnetis mōtes, nec ne, sub ambiguo relinquamus, scimus enim esse, qui scribāt planas magis esse eas regiones, de quo Paulus Iouius Ep̄us Nucerinus Luculētus historiarū nostri tēporis scriptor, circa eā Sarmatiæ partem, quæ Moscouia nūc dicitur, diligentē inquisitionem ab incolis fecit, qui ne eos etiā inueniri montes retulere, qui Rhyphēi ab antiquis dicti sunt: meminimus tamē nos quasdam chartas vidisse earum, quas mundi mappas appellāt, in quibus sub polo montes notati erant (qui Magnetis montes inscripti fuerant). Siue igitur sint, siue non sint ij montes, nihil ad nos in præsentiārum attinet, quando per montes polo subiectos catenam illam montium intelligimus, qui ad septentrionem spectant tanti, & tam vasti, ac Ferri & Magnetis feraces: qui, & si magis distant à nostro mari, q̄ Iluæ insulæ montes, potentiores tamen sunt ad mouendum perpendicularum propter abundantiam & copiā Ferri, & Magnetis. Fortasse autem, & qui in Ilua est Magnes, non multæ actionis est in ea minera: multi enim dū in minera sunt, minus valent, q̄ extracti, q̄ spirituales species sua habeant impedimenta: signum autem parum valere in sua minera Iluæ insulæ Magnetem, q̄ tam propinquus quum sit nauigijs illac prætereuntibus, perpendicularum tamen non ad se cōuertit.”

Aldrovandi in the *Musæum Metallicum* (Bonon., 1648, p. 554) gives another version of the fable:

“Nonnulli, animaduersa hac Magnetis natura, scripserunt naves, quibus in Calecutanam regionem navigatur, clavis ferreis non figi, ob magneticorum frequentiam scopulorum, quoniam facilè dissoluerentur. Sed Garzias in Historia Aromatum id fabulosum esse tradidit: quandoquidem plures naues Calecutanæ regionis, & illius tractus, ferreis clavis iunctas obseruauit: immò addidit naues in insulis Maldiuīs ligneis quidem clavis copulari, non quia à Magnete sibi metuant, sed quoniam ferri inopia laborant.”

According to Aldrovandi (p. 563, *op. citat.*) the magnetic mountains are stated by Sir John Mandeville to be in the region of Pontus.

Lipenius in his *Navigatio Salomonis Ophritica illustrata* (Witteb., 1660), which is a mine of curious learning, in discussing the magnetic mountains quotes the reply of Socrates to the inquirer who asked him as to what went on in the infernal regions, saying that he had never been there nor had he ever met any one who had returned thence.

The loadstone rock figures in several early charts. In Nordenskiöld's *Facsimile Atlas* (Stockholm, 1889) is given a copy of the Map of Johan Ruysch from an edition of Ptolemy, published in Rome in 1508, which shows four islands within the ice-bound Arctic regions. South of these islands and at the east of the coast of Greenland is the inscription: *Hic compassus navium non tenet, nec naves quæ ferrum tenent revertere valent.* To which (on p. 63) Nordenskiöld adds the comment: *Sagan om magnetberg, som skulle draga till sig fartyg förande jern, är gamal.* And he recalls the reference of Ptolemy to the magnetic rocks in the Maniöles. A second inscription is added to Ruysch's map in the ornamental margin that borders the Arctic islands. *Legere est in libro de inventionē fortunati sub polo arctico rupem esse excelsam ex lapide magnete 33 miliarium germanorum ambitu.* This refers to a matter recorded in Hakluyt's *Principall Navigations* (Lond., 1589, p. 249), namely: “A Testimonie of the learned Mathematician, maister John Dee,

touching the foresaid voyage of Nicholas de Linna. Anno 1360 a frier of Oxford, being a good Astronomer, went in companie with others to the most Northren islands of the world, and there leaving his company together, he travelled alone, and purposely described all the Northern islands, with the indrawing seas: and the record thereof at his return he delivered to the king of England. The name of which booke is *Inventio Fortunata (aliter fortunæ) qui liber incipit a gradu 54 usq. ad polum.*"

The situation of the alleged loadstone rock is thus described by T. Blundevile in his *Exercises* in the chapter entitled *A plaine and full description of Peter Plancius his vniuersall Map, seruing both for sea and land, and by him lately put foorth in the yeare of our Lord, 1592.* . . . Written in our mother tongue by M. Blundeuill, Anno Domini 1594. The passage is quoted from p. 253 of the third edition (1606):

"Now betwixt the 72. and 86. degrees of North latitude he setteth downe two long Ilands extending from the West towards the East somewhat beyond the first Meridian, and from the saide Meridian more Eastward he setteth downe other two long Ilandes . . . and hee saith further that right under the North pole there is a certaine blacke and most high rocke which hath in circuite thirtie and three leagues, which is nintie and nine miles, and that the long Iland next to the Pole on the West is the best and most healthfull of all the North parts. Next to the foresaide Ilandes more Southward hee setteth downe the Ilandes of Crocklande and Groynelande, making them to haue a farre longer and more slender shape then all other mappes doe. . . . Moreouer at the East end of the last Ilande somewhat to the Southwarde, he placeth the Pole of the Lodestone which is called in Latine Magnes, euen as Mercator doth in his Mappe who supposing the first Meridian to passe through Saint Marie or Saint Michael, which are two of the outermost Ilandes of the Azores Eastwarde, placeth the Pole of the stone in the seuentie fue degree of Latitude, but supposing the first Meridian to passe through the Ile Coruo, which is the furthest Ile of the Azores Westwarde, he placeth the Pole of the Lodestone in the seuentie feuen degree of Latitude."

Further, in the chapter on *The Arte of Nauigation* in the same work (p. 332, *ed. citat.*), Blundevile says:

"But whereas Mercator affirmeth that there should bee a mine or great rocke of Adamant, wherunto all other lesser rockes or Needles touched with the Lodestone doe incline as to their chiefe fountaine, that opinion seemeth to mee verie straunge, for truely I rather belecue with Robert Norman that the properties of the Stone, as well in drawing steele, as in shewing the North Pole, are secret vertues given of GOD to that stone for mans necessarie vse and behoofe, of which secrete vertues no man is able to shewe the true cause."

The following is one of the inscriptions in the compartments of the great Chart of Mercator entitled *Ad Usus Navigantium*, published in 1569:

"Testatur Franciscus Diepanus peritissimus nauarchus volubiles libellas, magnetis virtute infectas recta mundi polum respicere in insulis C. Viridis, Solis, Bonauista, et Maio, cui proxime astipulantur qui in Tercera, aut S. Maria (insulæ sunt inter Açores) id fieri dicunt, pauci in earundem occidentalissima Corvi nomine id contingere opinantur. Quia vero locorum longitudinis a communi magnetis et mundi meridiano iustis de causis initium sumere oportet, plurium testimonium sequutus primum meridianum per dictas C. Viridis insulas protraxi, et quum alibi plus minusque a polo deuiante

magnete polum aliquum peculiarem esse oporteat quo magnetes ex omni mundi parte despiciant, eum hoc quo assignavi loco existere adhibita declinatione magnetis Ratisbonæ observata didici. Supputavi autem eius poli situm etiam respectu insulæ Corui, ut iuxta extremo primi meridiani positus extremi etiam termini, intra quos polum hunc inueniri necesse est, conspici fierent, donec certius aliquod nauclerorum observatio attulerit."

Not all the map-makers were as frank as Paulus Merula, the author of a *Cosmographia Generalis*, printed by Plantin in 1605, at Leyden. For in the description of his *tabula universalis* (op. citat. lib. iii., cap. 9) he says that he does not believe in the magnetic islands; but that he has put them into his chart lest unskilful folk should think that he had been so careless as to leave them out!

In the well-known myth of Ogier the Dane, immortalized by William Morris in the *Earthly Paradise* (London, 1869, vol. i., p. 625), the loadstone rock is an island in the far North. But this story is not one of the Scandinavian sagas, and belongs to the Carolingian cycle of heroic poems, of which the chief is the *Chanson de Roland*; and Ogier le Danois is really not a Dane but an *Ardennois*.

In the Middle-High German epic of Kudrun, the adventures of the fleet of Queen Hilda when attracted by the loadstone mountain at Givers, in the North Sea, are narrated at some length. (See *Kudrun, herausgegeben und erklärt von Ernst Martin*. Halle, 1872.) One stanza will serve as a sample:

1126. Ze Givers vor dem berge | lac daz Hilden her.
swie guot ir anker wæren, | an daz vinster mer.
magnêten die steine | heten si gezogen.
ir guote segelboume | stuonden alle gebogen.

which may be rendered :

1126. At Givers before the mountain | lay Hilda's ships by.
Though good their anchors were, | upon the murky sea.
Magnets the stones were | had drawn them thither.
Their good sailing masts | stood all bent together.

Recent magnetic research has shown that while there are no magnetic mountains that would account for the declination of the compass in general, yet there are minor local variations that can only be accounted for by the presence of magnetic reefs or rocks. The reader is referred to the account of the magnetic survey of Great Britain in the *Philosophical Transactions* (1890) by Professors Rücker and Thorpe. The well-known rocky peak the Riffelhorn above Zermatt, in Switzerland, produces distinct perturbations in the direction of the compass within half a mile of its base. Such local perturbations are regularly used in Sweden for tracing out the position of underground lodes of iron ore. See Thalén, *Sur la Recherche des Mines de Fer à l'aide de Mesures magnétiques* (Soc. Royale des Sciences d'Upsal, 1877); or B. R. Brough, *The Use of the Magnetic Needle in exploring for Iron Ore* (*Scientific American*, Suppl. No. 608, p. 9708, Aug. 27, 1887).

Quite recently Dr. Henry Wilde, F.R.S., has endeavoured to elucidate the deviations of the compass as the result of the configurations of land and sea on the globe, by means of a model globe in which the ocean areas are covered with thin sheet iron. This apparatus Dr. Wilde calls a *Magnetarium*. See *Proc. Roy. Soc.*, June, 1890, Jan., 1891, and June, 1891.

An actual magnetic rock exists in Scandinavia, the following account of it being given in the *Electrical Review* of New York, May 3, 1899 :

"The island of Bornholm in the Baltic, which consists of a mass of magnetic iron ore, is much feared by mariners. On being sighted they discontinue steering by compass, and go instead by lighthouses. Between Bornholm and the mainland there is also a dangerous bank of rock under water. It is said that the magnetic influence of this ore bank is so powerful that a balanced magnetic needle suspended freely in a boat over the bank will take a vertical position."

Page 5, line 35. Page 5, line 43. *Josephus Costa*.—This is unquestionably a misprint for *Acosta* (Joseph de), the Jesuit, whose work *Historia natural y moral de las Indias* was published at Seville in 1590. An Italian edition appeared at Venice in 1596. The English edition, translated by E. Grimestone, *The Naturall and Morall Historie of the East and West Indies*, was published in London in 1604 and 1878. There are in Gilbert's book references to two writers of the name of Costa or Costæus, Joannes Costa of Lodi, who edited Galen and Avicenna (see pp. 3 and 62), and Filippo Costa of Mantua, who wrote on antidotes and medicaments (see p. 141). The passage to which Gilbert refers is in Acosta's *Historia* (ed. 1590, p. 64).

"Deziame a mi vn piloto muy diestro Portugues q̃ eran quatro puntos en todo el orbe, donde se afixaua el aguja con el Norte, y contaualas por sus nombres, de que no me acuerdo bien. Vno destos es el paraje de la Isla del Cuero, en las Terceras, o Islas de Açores, como es cosa y a muy sabida. Passando di alli a mas altura, Noruestea, que es dezir, q̃ declina al Poniente . . . que me digã la causa desta efecto? . . . Porque vn poco de hierro de fregar se cõ la piedra Iman . . ."

"Mejor es, como dize Gregorio Theologo, que a la Fe se sujete la razon, pues aun en su casa no sabe bien entenderse. . . ."

Page 5, line 36. Page 5, line 45. *Livius Sanutus*.—Livio Sanuto published at Venice in 1588 a folio work, *Geografia distinta in xii Libri; ne' quali, oltre l'espliatione di nostri luoghi di Tolomeo, della Bussola e dell' Aguglia, si dichiarono le provincie . . . dell' Africa*. In this work all Liber i. (pages 1-13) deals with observations of the compass, mentioning Sebastian Cabot, and other navigators. He gives a map of Africa, showing the central lakes out of which flow the *Zaires fluvius* and the *Zanberes fluvius*.

Page 6, line 2. Page 6, line 5. *Fortunius Affaitatus*.—The work of Affaitatus, *Physicæ ac astronomiæ considerationes*, was published in Venice in 1549.

Page 6, line 3. Page 6, line 6. *Baptista Porta*.—The reference is to his celebrated *Magia naturalis*, the first edition of which came out in 1558 at Naples. An English edition, *Natural Magick by John Baptista Porta, a Neapolitaine*, was printed in London, 1658. Book seven of this volume treats "Of the wonders of the Load-stone." In the proem to this book Porta says: "I knew at Venice R. M. Paulus, the Venetian, that was busied in the same study: he was Provincial of the Order of servants, but now a most worthy Advocate, from whom I not only confess, that I gained something, but I glory in it, because of all the men I ever saw, I never saw any man more learned, or more ingenious, having obtained the whole body of learning; and is not only the Splendor and Ornament of Venice or Italy, but of the whole world." The reference is to Fra Paolo Sarpi, better known as the historian of the Council of Trent. Sarpi was himself known to Gilbert.

His relations with Gilbert are set forth in the memoir prefixt to the edition of his works, *Opere di Fra Paolo Sarpi, Servita . . .* in Helmstat, MDCCLXI, p. 83. "Fino a questi giorni continuava il Sarpi a raccorre osservazioni sulla declinazione dell' Ago Calamitato; e poi ch' egli, atteso il variare di tal declinazione, assurdità alcuna non trovava riguardo al pensamento dell' Inglese Guglielmo Gilberto, cioè, che l'interno del nostro Globo fosse gran Calamita. . . ." Here follows a quotation from a letter of Sarpi to Lescasserio :

" . . . Unde cuspidem trahi a tanta mole terrena, quæ supereminet non absurde putavit Gullielmus Gilbertus, et in eo meridiano respicere recta polum, cave putes observatorem errasse. Est Vir accuratissimus, et interfuit omnibus observationibus, quas plures olim fecimus, et aliquas in sui gratiam, et cum arcubus vertici cupreo innitentibus, et cum innatantibus aquæ, et cum brevibus, et cum longis, quibus modis omnibus et Hierapoli usus fuit."

Sarpi had correspondence with Gilbert, Bacon, Grotius, and Casaubon. He also wrote on magnetism and other topics in *materia di Fisica*, but these writings have perished. He appears to have been the first to recognize that fire destroyed the magnetic properties. (See *Fra Paolo Sarpi, the greatest of the Venetians* by the Rev. Alexander Robertson, London, 1894; see also the notice of Sarpi in Park Benjamin's *Intellectual Rise in Electricity*.)

Page 6, line 7. Page 6, line 11. *R. M. Paulus Venetus*. See preceding note.

Page 6, line 21. Page 6, line 28. *Franciscus Rueus*.—François de la Rue, author of *De Gemmis Aliquot . . .* (Paris, 1547). Amongst other fables narrated by Rueus is that if a magnet is hung on a balance, when a piece of iron is attracted and adheres to the magnet, it adds nothing to the weight!

Page 6, line 25. Page 6, line 33. *Serapio*.—This account of the magnetic mountains will be found in an early pharmacology printed in 1531 (Argentorati, G. Ulricher Andlenus), with the title "In hoc volumine continetur insignium medicorum Joan. Serapionis Arabis de Simplicibus Medicinis opus præclarum et ingens, Averrois Arabis de eisdem liber eximius, Rasis filius Zachariæ de eisdem opusculum perutile." It was edited by Otho Brunfels. Achilles P. Gasser, in his Appendix to the Augsburg edition of Peregrinus, gives a reference to Serapio Mauritanus, parte 2, cap. 394, libri *de medicinis compositis*.

Page 6, line 30. Page 6, line 39. *Olaus Magnus*. See note to p. 5.

Page 6, line 34. Page 6, line 44. *Hali Abas*.—A reference is given in Gasser's (1558) edition of Peregrinus to Haliabbas Arabs, lib. 2, *practicæ* cap. 45, *Regalis Dispositionis Medicinæ*. The passage to which Gilbert refers is found in the volume *Liber totius medicinæ necessaria continens . . . quem Haly filius Abbas . . . edidit . . . et a Stephano ex arabica lingua reductus*. (Lugd., 1523, 4to.) Liber Primus. Practice, Cap xlv. *de speciebus lapidum*, § 466. "Lapis magnetes filis ē vtute fadenego: & aiunt qm̄ si teneat^r in manu mitigat q̄ sunt in pedib⁹ ip̄is dolores ac spasmū."

Mr. A. G. Ellis identifies the noun *fadenegum* as a Latin corruption of the Arabic name of hæmatite, *shâdanaj*.

Page 6, line 36. Page 6, line 46. *Pistorius*.—His poem was published at Basel, 1567. See also note on Marbodæus, p. 7, line 20, below.

Page 6, line 36. Page 7, line 1. *Albertus Magnus*.—Albertus, the celebrated Archbishop of Ratisbon, is responsible for propagating sundry of the myths of the magnet; and Gilbert never loses a chance of girding at him.

The following examples are taken from the treatise *De mineralibus et rebus metallicis* (Liber II. *de lapidibus preciosis*), Venet., 1542.

p. 171. "Et quod mirabile videtur multis hic lapis [adamas] quando Magneti supponitur ligat Magnetem et non permittit ipsum ferrum trahere."

p. 193. "Vinctus autē lapis alleo non trahit, si superponitur ei Adamas iterum non attrahit, ita quod parvus Adamas magnū ligat Magnetē. Inventus autē est nostris tēporibus Magnes qui ab uno angulo traxit ferrū et ab alio fugavit, et hunc Aristot. ponit aliud genus esse Magnetis. Narravit mihi quidam ex nostris sociis experimētator quod uidit Federicum Imperatorem habere Magnetem qui non traxit ferrum, sed ferrum uiceuersā traxit lapidem."

The first edition of this work *de mineralibus* appears to have been published in Venice as a folio in 1495.

Page 7, line 9. Page 7, line 15. *Gaudentius Merula*.—This obscure passage is from Liber III., cap. xxi., *Lapides*, of the work *Memorabilium Gaudentii Merulae* . . . (Lugd., 1556), where we find :

"Qui magneti vrsæ sculpsit imaginem, quādo Luna melius illuc aspiciat, & filo ferreo suspēderit, compos fiet vrsæ cælestis virtutis: verū cum Saturni radiis vegetetur, satius fuerit eam imaginem non habere: scribunt enim Platonici malos dæmones septentrionales esse" (p. 287).

"Trahit autem magnes ferrum ad se, quod ferro sit ordine superior apud vrsū" (p. 287).

The almost equally obscure passage in the *De triplici vita* of Marsiglio Ficino (Basil., 1532) runs :

"Videmus in specula nautarum indice poli libratum acum affectum in extremitate Magnete moueri ad Vrsam, illuc uidelicet trahente Magnete: quoniam & in lapide hoc præualet uirtus Vrsæ, & hinc transfertur in ferrum, & ad Vrsam trahit utrunq;. Virtus autem eiusmodi tum ab initio infusa est, tum continue Vrsæ radijs uegetatur, Forsitan ita se habet Succinum ad polum alterum & ad paleas. Sed dic interea, Cur Magnes trahit ubiq; ferrum? non quia simile, alioquin & Magnetem Magnes traheret multo magis, ferrumq; ferrū: non quia superior in ordine corporum, imò superius est lapillo metallum. . . . Ego autem quum hæc explorata hætenus habuissem admodum gratulabar, cogitabamq; iuuenis adhuc Magneti pro uiribus in-fcluperet (*sic*) coelestis Vrsæ figuram, quando Luna melius illuc aspiciat, & ferro tūc filo collo suspendere. Sperabam equidem ita demum uirtutis me fideris illius compotem fore," &c. (p. 172).

Page 7, line 14. Page 7, line 20. *Ruellius*.—Joannes Ruellius wrote a herbal *De Natura Stirpium*, Paris, 1536, which contains a very full account of amber, and a notice of the magnet (p. 125) and of the fable about garlic. But on p. 530 of the same work he ridicules Plutarch for recording this very matter.

Page 7, line 20. Page 7, line 27. *Marbodæus Gallus*.—This rare little book is entitled *Marbodei Galli Poetæ vetustissimi de lapidibus pretiosis Enchiridion*. It was printed at Paris in 1531. The Freiburg edition, also of 1531, has the commentaries of Pictorius. The poem is in Latin hexameters. After a preface of twenty-one lines the virtues of stones are dealt with, the paragraph beginning with a statement that Evax, king of the Arabs, is said to have written to Nero an account of the species, names and colours of stones, their place of origin and their potencies; and that this work formed the basis of the poem. The alleged magical powers of the magnet are recited in Caput I., *Adamas*. Caput XLIII., *Magnes*, gives further myths.

The commentary of Pictorius gives references to earlier writers, Pliny, Dioscorides, Bartholomæus Anglicus, Solinus, Serapio, and to the book *de lapidibus* erroneously ascribed to Aristotle.

The following is a specimen of the poem of Marbodeus :

*Magnetes lapis est inuentus apud Trogloditas,
Quæ lapidæ genetrix nihilominus India mittit.
Hic ferruginei cognoscitur esse coloris,
Et ut naturæ vicinum tollere ferrum.
Ededon magus hoc primum ferè dicitur usus,
Conscius in magica nihil esse potentius arte.
Post illum fertur famosa uenefica Circe
Hoc in præstigijs magicis specialiter usa.*

This poem was reprinted (1854) in Migne's *Patrologia*. In 1799 Johann Beckmann issued an annotated variorum edition of Marbodeus (*Marbodi Liber Lapidum seu de Gemmis . . .*, Göttingæ, 1799), in which there is a bibliography of the poem, the first edition of which appears to have been published in 1511, at Vienna, thirteen other editions being described. Beckmann adds many illustrative notes, and a notice of the Arabian Evax, who is supposed to have written the treatise *de lapidibus*. Not the least curious part is a French translation alleged to have been written in 1096, of which Chap. XIX. on the Magnet begins thus :

*Magnete trovent Trogodite,
En Inde e precieus est ditte.
Fer resemble e si le trait,
Altresi cum laimant fait.
Dendor lama mult durement.
Qi lusoit a enchantement.
Circe lus a dot mult chere,
Cele merueilleuse forcierre, &c.*

Page 7, line 21. Page 7, line 28. *echeneidis*.—The *echeneis*, or sucking-fish, reputed to have magical or magnetic powers, is mentioned by many writers. As an example, see Fracastorio, *De Sympathia et Antipathia*, lib. i., cap. 8, *De Echineide, quomodo firmare nauigia possit* (Giunta edition, Venet., 1574, p. 63). For other references to the *Echeneis* see Gaudentius Merula (*op. citat.*), p. 209. Also Dr. Walter Charleton, *Physiologia Epicuro Gassendo-Charltoniana* (Lond., 1654), p. 375. Compare p. 63, line 3.

Page 7, line 33. Page 7, line 43. *Thomas Hariotus*, etc.—The four Englishmen named were learned men who had contributed to navigation by magnetic observations. Harriot's account of his voyage to Virginia is printed in Hakluyt's *Voyages*. Robert Hues (or Hood) wrote a treatise *on Globes*, the Latin edition of which appeared in 1593 (dedicated to Sir Walter Raleigh), and the English edition in 1638. It was republished by the Hakluyt Society, 1889. Edward Wright, the mathematician and writer on navigation, also wrote the preface to Gilbert's own book. Abraham Kendall, or Abram Kendal was "Portulano," or sailing-master of Sir Robert Dudley's ship the *Bear*, and is mentioned in Dudley's *Arcano del Mare*. On the return of Dudley's expedition in 1595, he joined Drake's last expedition, which failed that year, and died on the same day as Drake himself, 28 January, 1596. (See Hakluyt, ed. 1809, iv., p. 73.)

Page 7, line 36. Page 8, line 1. *Guilielmus Borough*.—Borough's book has the title: *A Discours of the Variation of the Cumpas, or magneticall*

Needle. Wherein is Mathematically shewed, the manner of the obseruation, effectes, and application thereof, made by W. B. And is to be annexed to *The Newe Attraetive* of R. N., 1581 (London).

Page 7, line 37. Page 8, line 2. *Guilielmus Barlo.*—Archdeacon William Barlowe (author, in 1616, of the *Magneticall Aduertisements*) wrote in 1597 a little work called *The Navigators Supply*. It gives a description of the ordinary compass, and also one of a special form of meridian compass provided with sights for taking the bearings by the sun.

Page 7, line 37. Page 8, line 3. *Robertus Normannus.* See Note to p. 5.

Page 8, line 14. Page 8, line 21. *illo fabuloso Plinij bubulco.*—The following is Pliny's account from Philemon Holland's English version of 1601 (p. 586): "As for the name Magnes that it hath, it tooke it (as *Nicander* saith) of the first inventor and deviser thereof, who found it (by his saying) upon the mountaine Ida (for now it is to be had in all other countries, like as in Spaine also;) and (by report) a Neat-heard he was: who, as he kept his beasts upon the aforefaid mountaine, might perceive as he went up and downe, both the hob-nailes which were on his shoes, and also the yron picke or graine of his staffe, to sticke unto the said stone."

Page 9, line 22. Page 9, line 30. *Differentiæ priscis ex colore.*—Pliny's account of the loadstones of different colours which came from different regions is mainly taken from Sotacus. The white magnet, which was friable, like pumice, and which did not draw iron, was probably simply magnesia. The blue loadstones were the best. See p. 587 of Holland's translation of Pliny, London, 1601. St. Isidore (*Originum seu Etymologiarum*, lib. xvi., cap. 4) says: "Omnis autem magnes tanta melior est, quanto [magis] cæruleus est."

Page 10, line 29. Page 10, line 42. *Suarcebergo . . . Snebergum & Annebergum.*—In the Stettin editions of 1628 and 1633 these are spelled *Swarcebergs . . . Schnebergum & Annebergum*. The Cordus given as authority for these localities is Valerius Cordus, the commentator on Dioscorides.

Page 11, line 3. Page 11, line 12. *Adriani Gilberti viri nobilis.*—"Adrian Gylbert of Sandridge in the Countie of Devon, Gentleman" is the description of the person to whom Queen Elizabeth granted a patent for the discovery of a North-West passage to China. See Hakluyt's *Voyages*, vol. iii., p. 96.

Page 11, line 17. Page 11, line 28. *Dicitur a Græcis ἡράκλειος.*—The discussion of the names of the magnet in different languages by Gilbert in this place is far from complete. He gives little more than is to be found in Pliny. For more complete discussions the reader is referred to Buttmann, *Bemerkungen über die Benennungen einiger Mineralien bei den Alten, vorzüglich des Magnetes und des Basaltes* (Museum der Alterthumswissenschaft, Bd. II., pp. 5-52, and 102-104, 1808); G. Fournier, *Hydrographie* (livre xi., chap. 1, 1643); Ulisse Aldrovandi, *Museum Metallicum* (Bononiæ, 1648, lib. iv., cap. 2, p. 554); Klaproth, *Lettre à M. le Baron A. de Humboldt, sur l'invention de la Boussole*, Paris, 1834; T. S. Davies, *The History of Magnetical Discovery* (Thomson's *British Annual*, 1837, pp. 250-257); Th. Henri Martin, *De l'Aimant, de ses noms divers et de ses variétés suivant les Anciens* (Mémoires présentées par divers savants à l'Académie des Inscriptions et Belles-lettres, 1^{re} série, t. vi., 1^{re} partie, 1861); G. A. Palm, *Der Magnet in Alterthum* (Programm des k. württembergischen Seminars Maulbronn, Stuttgart,

1867). Of these works, those of Klaproth and of Martin are by far the most important. Klaproth states that in modern Greek, in addition to the name *μαγνήτις*, the magnet also has the names *ἀδάμας* and *καλαμίτα*. The former of these, in various forms, *adamas*, *adamant*, *aimant*, *ymant*, and *piedramon*, has gone into many languages. Originally the word *ἀδάμας* (the unconquered) was applied by the Greeks to the hardest of the metals with which they were acquainted, that is to say, to hard-tempered iron or steel, and it was subsequently because of its root-signification also given by them to the diamond for the same reason; it was even given to the henbane because of the deadly properties of that plant. In the writings of the middle ages, in St. Augustine, St. Isidore, Marbodeus, and even in Pliny, we find some confusion between the two uses of *adamas* to denote the loadstone as well as the diamond. Certainly the word *adamas*, without ceasing to be applied to the diamond, also designated the loadstone. At the same time (says Martin) the word *magnes* was preserved, as Pliny records, to designate a loadstone of lesser strength than the *adamas*. On the other hand, the word *diamas*, or *deamans*, had already in the thirteenth century been introduced into Latin to signify the diamond as distinguished from the magnet. *Adamas* was rendered *aymant* in the romance version of the poem of Marbodeus on stones (see Beckmann's variorum edition of 1799, p. 102), and in this form it was for a time used to denote both the magnet and the diamond. Then it gradually became restricted in use to the stone that attracts iron.

Some confusion has also arisen with respect to the Hebrew name of the magnet. Sir W. Snow Harris makes the following statement (*Magnetism*, p. 5): "In the Talmud it [the loadstone] is termed *achzhab'th*, the stone which attracts; and in their ancient prayers it has the European name *magnēs*." On this point Dr. A. Löwy has furnished the following notes. The loadstone is termed in one of the Talmudical sections and in the Midrash, *Eben Shoebeth* (lapis attrahens). This would of course be written *אבן שואבת*. Omitting the *ו* which marks the participial construction, the words would stand thus: *אבן שאבת*. A person referring to Buxtorf's *Lexicon Talmudicum* would in the index look out for "Lapis magnesijs," or for "magnes." He would then, in the first instance, be referred to the two words already quoted. Not knowing the value of the letters of the Hebrew alphabet, he reads *אבן שואבת* thus: *אבן שאבת* *achzhab'th*. It is true that Buxtorf has inserted in his *Lexicon* the vocable *מַגְנֵיט*, "corruptum ex gr. *μάγνης*, *μαγνήτης*, *μαγνήτις*, named after the Asiatic city Magnesia." He goes on to say, "Inde Achilles Statius istum lapidem vocavit *μαγνήσιαν λίθον*. Hinc *אבן המגניסס חמשוך הברזל*. Lapis Magnesius trahit ferrum." Here he quotes from (Sepher) Ikkarem IV., cap. 35.

Kircher, in his *Magnes, sive de Arte magnetica* (Coloniæ, 1643), gives several other references to Hebrew literature. Others have supposed that the word *חלמיש*, *khallamish*, which signifies pebble, rock, or hard rock, to be used for the magnet.

As to the other Greek name, *σιδηρίτις*, or *λίθος σιδηρίτις*, this was given not only to the loadstone but also to non-magnetic iron. In the *Etymologicum magnum* (under the word *μαγνήτις*), and in Photius (*Quæst. amploloch.*, q. 131), it is stated that the name *sideritis* was given to the loadstone either because of its action on iron, or of its resemblance in aspect to iron, or rather, they say, *because the loadstone was originally found in the mines of this metal*. Alexander of Aphrodisias expressly says (*Quæstiones Physicæ*, II. 23) that

the loadstone appears to be nothing else than γῆ σιδηρεῖτις, the earth which yields iron, or the earth of iron.

Page 11, line 19. Page 11, line 29. *ab Orpheo*.—The reference is to v. 301-328 of the *Λιθικά*. The passage, as given in Abel's edition (Berol., 1881), begins:

Τόλμα δ' ἀθανάτους καὶ ἐνήϊ μιλίσσεται
μαγνήσση, τὴν δ' ἔξοχ' ἐφίλατο θούσιος Ἄρης,
οὐνεκεν, ὅπποτε κεν πελάσῃ πολιοῖο σιδήρου,
ἥντε παρθενικὴ τερενόχροα χερσὶν ἐλοῦσα
ἥϊθεον στέρνῳ προσπτύσσεται ἡμεροέντι,
ὥς ἥγ' ἀρπάζουσα ποτὶ σφετερόν δέμας αἰεὶ
ἄψ πάλιν οὐκ ἐθέλει μεθέμεν πολεμιστὰ σίδηρον.

Page 11, line 20. Page 11, line 31. *Gallis aimant*.—The French word *aimant*, or *aymant*, is generally supposed to be derived from *adamas*. Nevertheless Klaproth (*op. citat.*, p. 19) suggests that the word *aimant* is a mere literal translation into French of the Chinese word *thsu chy*, which is the common name of the magnet, and which means *loving stone*, or *stone that loves*. All through the east the names of the magnet have mostly the same signification, for example, in Sanskrit it is *thoumbaka* (the kisser), in Hindustani *tchambak*.

Page 11, line 20. Page 11, line 32. *Italis calamita*.—The name *calamita*, universal in Italian for the magnet, is also used in Roumanian, Croatian, Bosnian, and Wendish. Its supposed derivation from the Hebrew *khallamish* is repudiated by Klaproth, who also points out that the use of *καλαμίτα* in Greek is quite modern. He adds that the only reasonable explanation of the word *calamita* is that given by Father Fournier (*op. citat.*), who says:

“Ils (les marins français) la nomment aussi *calamite*, qui proprement en français signifie une *grenouille verte*, parce qu'avant qu'on ait trouvé l'invention de suspendre et de balancer sur un pivot l'aiguille aimantée, nos ancêtres l'enfermaient dans une fiole de verre demi-remplie d'eau, et la faisaient flotter, par le moyen de deux petits fétus, sur l'eau comme une grenouille.” Klaproth adds that he entirely agrees with the learned Jesuit, but maintains that the word *calamite*, to designate the little green frog, called to-day *le graisset*, *la raine*, or *la rainette*, is essentially Greek. For we read in Pliny (*Hist. Nat.*, lib. xxxii., ch. x.): “Ea rana quam Græci *calamiten* vocant, quoniam inter arundines, fruticesque vivat, minima omnium est et viridissima.”

Page 11, line 20. Page 11, line 32. *Anglis loadstone & adamant stone*.

The English term *loadstone* is clearly connected with the Anglo-Saxon verb *ledan*, to lead, and with the Icelandic *leider-stein*. There is no doubt that the spelling *lodestone* would be etymologically more correct, since it means *stone that leads*, not *stone that carries a load*. The correct form is preserved in the word *lode-star*.

The word *adamant*, from *adamas*, the mediæval word for both loadstone and diamond, also occurs in English for the loadstone, as witness Shakespeare:

“You draw me, you hard-hearted adamant
But yet you draw not iron; for my heart
Is true as steel.”

Midsummer Night's Dream, Act II., Scene 1.

Page 11, line 21. Page 11, line 33. *Germanis magnets, & siegelstein.* The Stettin edition of 1628 reads *Germanis Magnetstein, Belgis Seylsteen*; while that of 1633 reads *Germanis Magnetstein, Belgis Seylsteen*.

Page 11, line 26. Page 11, line 39. In this line the Greek sentence is, in every known copy of the folio of 1600, corrected in ink upon the text, *θαλῆς* being thus altered into *Θαλῆς*, and *ἀπομνεμονύσαι* into *ἀπομνεμονεύσαι*. Four lines lower, brackets have been inserted around the words (*lapidum specularium modo*). These ink corrections must have been made at the printers', possibly by Gilbert's own hand. They have been carried out as errata in the editions of 1628 and 1633. The "facsimile" Berlin reprint of 1892 has deleted them, however. Other ink corrections on pp. 14, 22, 38, 39, 47, 130, and 200 of the folio edition of 1600 are noted in due course.

Page 11, line 29. Page 11, line 45. *lapis specularis*. This is the mediæval name for *mica*, but in Elizabethan times known as talc or muscovy stone. Cardan, *De Rerum Varietate* (Basil., 1557, p. 418), lib. xiii., cap. lxxii., mentions the use of *lapis specularis* for windows.

Page 11, line 31. Page 11, line 46. *Germanis Katzenfilbar & Talke.* —In the editions of 1628 and 1633 this is corrected to *Germanis Katzenfilber & Talcke*. Goethe, in *Wilhelm Meister's Travels*, calls mica "cat-gold."

Page 12, line 30. Page 12, line 35. *integtum* appears to be a misprint for *integrum*, which is the reading of editions 1628 and 1633.

Page 13, line 4. Page 13, line 3. *μικρόγη seu Terrella*. Although rounded loadstones had been used before Gilbert's time (see Peregrinus, p. 3 of Augsburg edition of 1558, or Baptista Porta, p. 194, of English edition of 1658), Gilbert's use of the spherical loadstone as a model of the globe of the earth is distinctive. The name *Terrella* remained in the language. In *Pepys's Diary* we read how on October 2, 1663, he "received a letter from Mr. Barlow with a terella." John Evelyn, in his *Diary*, July, 1655, mentions a "pretty terella with the circles and showing the magnetic deviations."

A *Terrella*, 4½ inches in diameter, was presented in 1662 by King Charles I. to the Royal Society, and is still in its possession. It was examined in 1687 (see *Phil. Transactions* for that year) by the Society to see whether the positions of its poles had changed.

In Grew's *Catalogue and Description of the Rarities belonging to the Royal Society and preserved at Gresham College* (London, 1681, p. 364) is mentioned a *Terrella* contrived by Sir Christopher Wren, with one half immersed in the centre of a plane horizontal table, so as to be like a Globe with the poles in the horizon, having thirty-two magnet needles mounted in the margin of the table to show "the different respect of the *Needle* to the several *Points* of the *Loadstone*."

In Sir John Pettus's *Fleta Minor*, London, 1683, in the *Dictionary of Metallick Words* at the end, under the word *Loadstone* occurs the following passage:

"Another piece of Curiosity I saw in the Hands of Sir William Persal (since Deceased also) viz., a *Terrella* or *Load-stone*, of little more than 6 Inches Diameter, turned into a *Globular Form*, and all the *Imaginary Lines* of our *Terrestrial Globe*, exactly drawn upon it: viz., the *Artick* and *Antartick Circles*, the *two Tropicks*, the *two Colures*, the *Zodiack* and *Meridian*; and these *Lines*, and the several *Countrys*, artificially *Painted* on it, and all of them with their true *Distances*, from the two *Polar Points*, and to find the truth of those *Points*, he took two little pieces of a *Needle*, each of about half

an *Inch* in length, and those he laid on the *Meridian line*, and then with *Brass Compasses*, moved one of them towards the *Artick*, which as it was moved, still raised it self at one end higher and higher, keeping the other end fixt to the *Terrella*; and when it had compleated it Journy to the very *Artick Points*, it stood upright upon that *Point*; then he moved the other piece of *Needle* to the *Antartick Point*, which had its *Elevations* like the other, and when it came to the *Point*, it fixt it self upon that *Point*, and stood upright, and then taking the *Terrella* in my Hand, I could perfectly see that the two pieces of *Needles* stood so exactly one against the other, as if it had been one intire long *Needle* put through the *Terrella*, which made me give credit to those who held, That there is an *Astral Influence* that darts it self through the *Globe of Earth* from *North* to *South* (and is as the *Axel-Tree* to the *Wheel*, and so called the *Axis* of the *World*) about which the *Globe* of the *Earth* is turned, by an *Astral Power*, so as what I thought *imaginary*, by this *Demonstration*, I found *real*."

Page 13, line 20. Page 13, line 22. The editions of 1628 and 1633 give a different woodcut from this: they show the *terrella* lined with meridians, equator, and parallels of latitude: and they give the compass needle, at the top, pointing in the wrong direction.

Page 14, line 3. Page 14, line 3. The Berlin "facsimile" reprint omits the asterisk here.

Page 14, line 5. Page 14, line 6. *erectus* altered in ink in the folio to *erecta*. But *erectus* is preserved in editions 1628 and 1633. In Cap. IIII., on p. 14, both these Stettin editions insert an additional cut representing the *terrella* A placed in a tub or vessel B floating on water.

Page 14, line 34. Page 14, line 39. *variatione quadā*. The whole of Book IIII. is devoted to a discussion of the variation of the compass.

Page 16, line 28. Page 16, line 34. *aquæ*.—This curious use of the dative occurs also on p. 222, line 8.

Page 17, line 1. Page 17, line 1. *videbis*.—The reading *vibebis* of the 1633 edition is an error.

Page 18, line 24. Page 18, line 27. *Theamedem*.—For the myth about the alleged *Theamedes*, or repelling magnet, see Cardan, *De Subtilitate* (folio ed., 1550, lib. vii., p. 186).

Pliny's account, in the English version of 1601 (p. 587), runs:

"To conclude, there is another mountaine in the same *Æthyopia*, and not farre from the said *Zimiris*, which breedeth the stone *Theamedes* that will abide no yron, but rejecteth and driveth the same from it."

Martin Cortes, in his *Arte de Nauegar* (Seville, 1556), wrote:

"And true it is that *Tanxeades* writeth, that in *Ethiope* is found another kinde of this stone, that putteth yron from it" (Eden's translation, London, 1609).

Page 21, line 24. Page 21, line 25. *Hic segetes, &c.*—The English version of these lines from Vergil's *Georgics*, Book I., is by the late Mr. R. D. Blackmore.

Page 22, line 18. Page 22, line 19. *quale*, altered in ink in the folio text to *qualis*. The editions of 1628 and 1633 both read *qualis*.

Page 22, line 19. Page 22, line 20. *rubrica fabrili*: in English *ruddle* or *reddle*. See "Sir" John Hill, *A General Natural History*, 1748, p. 47. In the *De Re Metallica* of Entzelt (Encelius), Frankfurt, 1551, p. 134, is a paragraph headed *De Rubrica Fabrili*, as follows: "Rubrica fabrilis duplex

est. à Germanis añt utraque dicitur rottel, röttelstein, wie die zimmerleüt vnd steynmetzen brauchen. à Græcis μίλτος τεκτονική. Est enim alia nativa, alia factitia. Natiua à Germanis propriè dicitur berckrottel. haec apud nos est fossilis. . . . Porro factitia est rubrica fabrilis, à Germanis braunrottel, quæ fit ex ochra usta, ut Theophrastus et Dioscorides testantur."

Page 22, line 19. Page 22, line 20. *In Suffexia Angliæ.*—In Camden's *Britannia* (1580) we read concerning the iron industry in the villages in Suffex: "They are full of iron mines in sundry places, where, for the making and founding thereof, there be furnaces on every side; and a huge deal of wood is yearly burnt. The heavy forge-hammers, worked by water-power, stored in hammer-ponds, ceaselessly beating upon the iron, fill the neighbourhood round about, day and night, with continual noise."

Page 23, line 1. Page 22, line 44. *in libro Aristotelis de admirandis narrationibus.*—The reference is to the work usually known as the *De Mirabilibus Auscultationibus*, Cap. XLVIII.: "Fertur autem peculiarissima generatio esse ferri Chalybici Amisenique, ut quod ex fabulo quod a fluviis defertur, ut perhibent certe, conflatur. Alii simpliciter lotum in fornace excoqui, alii vero, quod ex lotura subsedit, frequentius lotum comburi tradunt adjecto simul et pyrimacho dicto lapide, qui in ista regio plurimus reperiri fertur." (Ed. Didot, vol. ii., p. 87.) According to Georgius Agricola, the stone pyrimachus is simply iron pyrites.

Page 23, line 22. Page 23, line 23. *ut in Italia Comi, &c.*—This is mostly taken from Pliny. Compare the following passage from Philemon Holland's translation (1601), p. 514:

"But the most varietie of yron commeth by the meanes of the water, wherein the yron red-hot is eftsoones dipped and quenched for to be hardened. And verely, water only which in some place is better, in other worse, is that which hath ennobled many places for the excellent yron that commeth from them, as namely, Bilbilis in Spaine, and Tarassio, Comus also in Italie; for none of these places have any yron mines of their owne, and yet there is no talke but of the yron and steele that commeth from thence."

Bilbilis is Bambola, and Tariaßona the Tarazona of modern Spain.

Page 24, line 28. Page 24, line 27. *Quare vani sunt illi Chemic.*—Gilbert had no faith in the alchemists. On pp. 19 and 21 he had poked fun at them for declaring the metals to be constituted of sulphur and quicksilver, and for pronouncing the fixed earth in iron to be sulphur. On p. 20 he had denied their proposition that the differences between silver, gold, and copper could arise from proportions of their constituent materials; and he likewise denounced unsparingly the supposed relation between the seven metals and the seven planets. He now denounces the vain dreams of turning all metals into gold, and all stones into diamonds. Later he rejects as absurd the magnetic curing of wounds. His detachment from the pseudo-science of his age was unique if not complete.

Page 25, line 15. Page 25, line 16. *Petro-coriis, & Cabis Biturgibus.*—The Petro-corii were a tribe in the neighbourhood of Perigord; the Cubi Biturges another in that of Bourges.

Page 25, line 21. Page 25, line 23. Pliny's account, as translated by P. Holland (ed. 1601, p. 515), runs thus:

"Of all mines that be, the veine of this mettall is largest, and spreadeth it selfe into most lengths every way: as we may see in that part of Biscay that coasteth along the sea, and upon which the Ocean beateth: where there

is a craggie mountaine very steep and high, which standeth all upon a mine or veine of yron. A wonderfull thing, and in manner incredible, howbeit, most true, according as I have shewed already in my Cosmographie, as touching the circuit of the Ocean."

Page 26, line 15. Page 26, line 12. *quas Clampas nostri vocant.*—The name *clamp* for the natural kiln formed by heaping up the bricks, with ventilating spaces and fuel within the heap, is still current.

Page 26, line 39. Page 26, line 38. *Pluebat in Taurinis ferrum.*—The occurrence is narrated by Scaliger, *De Subtilitate*, Exercitat. cccxxiii.:

"Sed falso lapidis pluviam creas tu ex pulvere hausto à nubibus, atque in lapidem condensato. At ferrum, quod pluit in Taurinis, cuius frustum apud nos extat, qua ex fodina sustulit nubes? Tribus circiter annis antè, quàm ab Rege provincia illa recepta esset, pluit ferro multis in locis, sed raris" (p. 434, Editio Lutetiæ, 1557).

"During the latter ages of the Roman Empire the *city* of Augusta Taurinorum seems to have been commonly known (as was the case in many instances in Transalpine Gaul) by the name of the tribe to which it belonged, and is called simply Taurini in the Itineraries, as well as by other writers, hence its modern name of Torino or Turin" (Smith's *Dictionary of Greek and Roman Geographies*, p. 1113).

There exists a considerable literature respecting falls of meteors and of meteoric iron. Livy, Plutarch, and Pliny all record examples. See also *Remarks concerning stones said to have fallen from the clouds*, by Edward King (London, 1796); Chladni, *Ueber den Ursprung der von Pallas gefundenen und anderer ihr ähnlicher Eisenmassen* (Riga, 1794); *Philosophical Transactions*, vol. lxxviii., pp. 37 and 183; vol. lxxxv., p. 103; vol. xcii., p. 174; Humboldt's *Cosmos*, vol. i. (p. 97 of London edition, 1860); C. Rammelsberg, *Die chemische Natur der Meteoriten* (Berlin, 1879); Maskelyne, *Some lecture-notes on Meteorites* printed in *Nature*, vol. xii., pp. 485, 504, and 520, 1875. Maskelyne denominates as *siderites* those meteorites which consist chiefly of iron. They usually contain from 80 to 95 per cent. of iron, often alloyed with nickel. This meteoric iron is sometimes so pure that it can at once be forged by the smith. An admirable summary of the whole subject is to be found in L. Fletcher's *An Introduction to the Study of Meteorites*, published by the British Museum (Nat. Hist.), London, 1896.

Page 27, line 3. Page 26, line 41. *ut Cardanus . . . scribit.*—The passage runs:

"Vidimus anno MDX cum cecidisset è cœlo lapides circiter MCC in agrum fluvio Abduæ conterminum, ex his unum CXX pondo, alium sexaginta delati fuerunt ad reges Gallorū satrapes, plurimi: colos ferrugineus, durities eximia, odor sulphureus" (Cardan, *De Rerum Varietate*, lib. xiiii., cap. lxxii.; Basil., 1557, p. 545).

Page 27, line 9. Page 27, line 2. *aut stannum, aut plumbum album.* Although most authorities agree in translating *plumbum album* or *plumbum candidum* as "tin" (which is unquestionably the meaning in such examples as Pliny's *Nat. Hist.*, xxxiv. 347, and iv. 16; or Strabo, iii. 147), nevertheless it is certain that here *plumbum album* is not given as a synonym of *stannum* and therefore is not *tin*. That Gilbert meant either spelter or pewter is pretty certain. He based his metallic terms mainly upon Encelius (Christoph Entzelt) whose *De Re Metallica* was published at Frankfurt in 1551. From this work are taken the following passages:

p. 61. *De Plumbo candido.* Cap. XXXI.

"Veluti plumbum nigrū uocatur à Germanis blei simpliciter, od' schwartzblei: ita plumbū candidū ab his uocatur weißblei, od' zīñ. Impropiè autem plumbum hoc nostrum candidum zīñ, stannum dicitur. Et non sunt idem, ut hactenus voluerunt, stannum et plumbum candidum, unfer zīñ. Aliud est stannum, de quo mox agemus: et aliud plumbum candidum nostrum, unfer zīñ, quod nigro plumbo quasi est quiddā purius et perfectius. . . ."

p. 62. *De Stanno.* Cap. XXXII.

"In præcedenti capite indicauimus aliud esse stannum, aliud esse plumbū candidū. Illa ergo definitio plumbi candidi, desz zīnnes, etiā apud chimistas nō de stanno, sed de plumbo candido (ut mihi uidetur) intelligenda est, cum dicunt: Stannum (es soll heyssen plumbum candidum) est metallicum album, non purum, lividum. . . ."

p. 63. "Sic uides stannum, secundum Serapionem, metallicum esse quod reperitur in sua propria uena, ut forsitan apud nos bisemutū: ecōtra nostrū candidū plumbū, est Plinij candidū plumbū, das zin, quod cōflatur ut plumbum nigrum, ex pyrite, galena, et lapillis nigris. Deinde uides stannum Plinio esse quiddā de plumbo nigro, nempe primum fluorem plumbi nigri, als wann man vnser bley ertz schmelztet, das erst das do fleüßet, zwäre Plinio stannum. Et hoc docet Plinius adulterari plūbo candido, mit vnserm zinn, vnd wann du ihm recht nachdenckest, daruon die kannen gemacht werden, das man halbwerck heist. . . . O ir losen vngelerten, vnckenbrenner. Stannum proculdubio Arabis metallum est preciosius nostro candido plumbo: sicuti apud nos bisemuthum quiddam plumbo preciosius."

Page 27, line 21. Page 27, line 17. *venas . . . venis.*—It is impossible to give in English this play on words between veins of ore and veins of the animal body.

Page 28, line 23. Page 28, line 20. *quem nos verticitatem dicimus.*—See the notes on Gilbert's glossary, *ante*. The word verticity remained in the language. On p. 140 of Joseph Glanvill's *Vanity of Dogmatizing* (Lond., 1661) we read: "We believe the *verticity* of the Needle, without a Certificate from the *dayes of old*."

Page 29, line 15. Page 29, line 16. *Nos verò diligentius omnia experientes.*—The method of carefully trying everything, instead of accepting statements on authority, is characteristic of Gilbert's work. The large asterisks affixed to Chapters IX. X. XI. XII. and XIII. of Book I. indicate that Gilbert considered them to announce important original magnetical discoveries. The electrical discoveries of Book II., Chapter II., are similarly distinguished. A rich crop of new magnetical experiments, marked with marginal asterisks, large and small, is to be found in Book II., from Chapter XV. to Chapter XXXIV.; while a third series of experimental magnetical discoveries extends throughout Book III.

Page 31, line 30. Page 31, line 25. *verticem.*—The context and the heading of the Chapter appear to require *verticitatem*. All editions, however, read *verticem*.

Page 32, line 12. Page 32, line 9. *Gartias ab horto.*—The passage from Gartias ab Horto runs as follows in the Italian edition of 1616, *Dell' Historia dei Semplici Aromati*. . . . di Don Garzia dall' Horto, Medico Portughefe, . . . Venezia MDCXVI., p. 208.

"Nè meno è questa pietra velenosa, si come molti hanno tenuto; imperoche le genti di queste bande dicono che la Calamita presa per bocca, però in poca

quantità, conserva la gioventù. La onde si racconta, che il Re di Zeilan il vecchio l'haveva fatto fare tutti i vasi, dove si cocevano le vivande per lui, di Calamita. Et questo lo disse à me colui proprio, che fu à questo officio destinato."

Page 32, line 29. Page 32, line 29. *Plutarchus & C. Ptolemæus.*—The garlick myth has already been referred to in the note to p. 1. The originals are Plutarch, *Quæstiones Platonicæ*, lib. vii., cap. 7, § 1; C. Ptolemæus, *Opus Quadripartitum*, bk. i., cap. 3. The English translation of the latter, by Whalley (London, 1701), p. 10, runs: "For if the *Loadstone* be *Rubbed* with *Garlick*, the *Iron* will not be drawn by it."

Page 32, line 32. Page 32, line 33. *Medici nonnulli.*—This is apparently a reference to the followers of Rhazes and Paracelsus. The argument of Gilbert as to the inefficacy of powdered loadstones is reproduced more fully by William Barlowe in his *Magneticall Aduertisements* (1616, p. 7), as follows:

"It is the goodnesse of the *Loadstone* ioyned with a fit forme that will shew great force. For as a very good forme with base substance can doe but very litle, so the substance of the *Loadstone* bee it neuer so excellent, except it haue some conuenient forme, is not auailable. For example, an excellent *loadstone* of a pound waight and of a good fashion, being vsed artificially, may take vp foure pounds of Iron; beate it into small powder, and it shall bee of no force to take vp one ounce of Iron; yea I am very well assured that halfe an ounce of a *Loadstone* of good fashion, and of like vertue will take vp more then that pound will doe being beaten into powder. Whence (to adde this by the way) it appeareth manifestly, that it is a great error of those Physitions and Surgeons, which to remedy ruptures, doe prescribe vnto their Patients to take the powder of a *Loadstone* inwardly, and the small filing of iron mingled in some plaister outwardly: supposing that herein the *magneticall* drawing should doe great wonders."

Page 33, line 11. Page 33, line 8. *Nicolaus in emplastrum divinum* . . .—Nicolaus Myrepsus is also known as Præpositas. In his *Liber de compositione medicamentorum* (Ingoldstat, 1541, 4to) are numerous recipes containing loadstone: for example, Recipe No. 246, called "esdra magna," is a medicine given for inflammation of the stomach and for strangury, compounded of some forty materials including "litho demonis" and "lapis magnetis." The *emplastrum divinum* does not, however, appear to contain loadstone. In the English tractate, *Præpositas his Practise, a worke . . . for the better preservation of the Health of Man. Wherein are . . . approved Medicines, Receiptes and Ointmentes. Translated out of Latin in to English by L. M.* (London, 1588, 4to), we read on p. 35, "An Emplaister of D. N. [Doctor Nicolaus] which the Pothecharies call Divinum." This contains litharge, bdellium, and "green brasse," but no loadstone.

Luis de Oviedo in his treatise *Methodo de la Coleccion y reposicion de las Medicinas simples*, edited by Gregorio González, Boticario (Madrid, 1622), gives (p. 502) the following: "Emplasto de la madre. Recibe: Nuezes moscadas, clauos, cinamono, artemisia, piedraimon. De cada uno dos onças. . . . Entre otras diferencias que ay de piedraiman se hallan dos. Vna que por la parte que mira al Septentrion, atrae el hierro, por lo quel se llama magnes ferrugineus. Y otra que atrae la carne, a la qual llaman magnes creaginus."

An "Emplastrum sticticum" containing amber, mummy, loadstone,

hæmatite, and twenty other ingredients, and declared to be "vulnerum ulcerumque telo inflictorum ficticum emplastrum præstantissimum," is described on p. 267 of the *Basilica chimica* of Oswaldus Crollius (Frankfurt, 1612).

Page 33, line 12. Page 33, line 9. *Augustani . . . in emplastrum nigrum.* . . .—Amongst the physicians of the Augsburg school the most celebrated were Adolphus Occo, Ambrosio Jung, and Gereone Seyler. This particular reference is to the *Pharmacopœia Augustana . . . a Collegio Medico recognita*, published at Augsburg, and which ran through many editions. The recipe for the "*emplastrum nigrum vulgo Stichpflaster*" will be found on p. 182 of the seventh edition (1621-2). The recipe begins with oil of roses, colophony, wax, and includes some twenty-two ingredients, amongst them mummy, dried earthworms, and two ounces *lapidis magnetis præparati*. The recipe concludes: "Fiat Emplastrum secundum artem. Perquam efficax ad recentia vulnera et puncturas, vndè denominationem habet." The volume is a handsome folio not unlike Gilbert's own book, and bears at the end of the prefatory address *ad Lectorem* identically the same *cul de lampe* as is found on p. 44 of *De Magnete*.

The contradictions as to the alleged medicinal virtues of loadstone are well illustrated by Galen, who in his *De facultatibus* says that loadstone is like hæmatite, which is astringent, while in his *De simplici medicina* he says it is purgative.

Page 33, line 14. Page 33, line 12. *Paracelsus in fodicationum emplastrum.*—Paracelsus's recipe for a plaster against stab-wounds is to be found in *Wundt vund Leibartznei . . . D. Theoph. Paracelsus* (Frankf., 1555, pp. 63-67).

Page 33, line 17. Page 33, line 15. *Ferri vis medicinalis.*—This chapter on the medicinal virtues of iron is a summary of the views held down to that time. Those curious to pursue the subject should consult Waring's *Bibliotheca Therapeutica* (London, 1878). Nor should they miss the rare black-letter quarto by Dr. Nicholas Monardus, of Seville, *Joyfull Newes out of the New-found Worlde*, translated by John Frampton (London, 1596), in which are recited the opinions of Galen, Rhazes, Avicenna, and others, on the medicinal properties of iron. In addition to the views of the Arabic authors, against whom his arguments are directed, Gilbert discusses those of Joannes Manardus, Curtius, and Fallopius. The treatise of Manardus, *Epistolarum medicinalium libri viginti* (Basil., 1549), is a *résumé* of the works of Galen and the Arabic physicians, but gives little respecting iron. Curtius (Nicolaus) was the author of a book, *Libellus de medicamentis præparatibus et purgantibus* (Gieslæ Cattorum, 1614). The works of Fallopius are *De Simplicibus Medicamentis purgentibus tractatus* (Venet., 1566, 4to), and *Tractatus de Compositione Medicamentorum* (Venet., 1570, 4to).

Page 34, line 7. Page 34, line 3. *quorundā Arabum opiniones.*—The Arabian authorities referred to here or elsewhere by Gilbert are:

Albategnius (otherwise known as Machometes Araçtenfis), Muhammad Ibn Jābir, *Al-Battānī*.

Avicenna (otherwise Abohali). Abou-'Ali al-'Hosēin ben-'Abd-Allah Ibn-Sinā, or, shortly, *Ibn Sīna*.

Averroes. Muhammad Ibn Ahmed Ibn-Roschd, *Abou Al-Walid*.

Geber. Abū Mūsā Jābir Ibn Haiyān, *Al-Tarjūsi*.

Hali Abas. 'Alī Ibn Al-'Abbās, *Al-Majūfī*.

Rhazes, or *Rafis*. Muhammad Ibn Zakariyā.

Serapio. Yuhannā Ibn Sarapion.

Thebit Ben-Kora (otherwise Thabit Ibn Corrah). Abū Thabit Ibn Kurrāh, *Al Harranī*.

Page 34, line 38. Page 34, line 40. *eleſtuarium de ſcoria ferri deſcriptum à Raze*.—Rhazes or Rafis, whoſe Arabic name was Muhammad Ibn Zakariyā, wrote *De Simplicibus, ad Almanſorem*. In Chap. 63 of this work he gives a recipe for a ſtomachic, which includes fennel, anife, origanum, black pepper, cinammon, ginger, and iron ſlag. In the ſplendid folio work of Rhazes publiſht at Venice in 1542, with the title *Habes candide leſtor Continētem Rafis*, Libri ultimi, cap. 295, under the heading *De Ferro*, are ſet forth the virtues of iron ſlag: “Virtus ſcorie eſt ſicut virtus ſcorie [a]eris ſed debilior in purgādo: et erugo ferri eſt ſtiptica: et cū ſuperpoſitur retinet fluxus menſtruorū. . . . Ait Paulus: aqua in qua extinguitur ferrū calens. . . . Dico: certificatus ſum experientia q̄ valet contra emorroyodas diabetem et fluxum menſtruorum.”

Page 35, line 16. Page 35, line 13. *Paulus*.—This is not Fra Paolo Sarpi, nor Marco Polo, nor Paulus Jovius the hiſtorian, nor Paulus Nicolettus Venetus, but Paulus Aeginæ.

Page 35, line 29. Page 35, line 28. *Sed malè Avicenna*.—The advice of Avicenna to adminiſter a draught containing powdered loadſtone, reads as follows in the Giunta edition (Venice, 1608):

Lib. ii., cap. 470, p. 356. “Magnes quid eſt? Eſt lapis qui attrahit ferrum, quum ergo aduritur, fit hæmatites, & virtus ejus eſt ſicut virtus illius. . . . Datur in potu [ad bibitionem limaturæ ferri, quum retinetur in ventre ſcoria ferri. Ipſe enim extrahit] ipſam, & aſſociatur ei apud exitum. Et dicitur, quando in potu ſumuntur ex eo tres anulufat cum mellicrato, educit ſolutione humorem groſſum malum.”

The paſſage is identical with that in the Venetian edition of 1486, in both of which the liquid preſcribed is mellicratus—mead. Gilbert ſays that the iron is to be given in juice of *mercurialis*. Here he only follows Matthiolus, who, in his *Commentaries on Dioſcorides*, ſays (p. 998 of the Baſil. edition of 1598): “Sed (vt idem Auicenna ſcribit) proprium huiuſce ferrei pharmaci antidotum, eſt lapis magnes drachmæ pondere potus, ex mercurialis, vel betæ ſucco.”

Serapio, in his *De Simplicibus Medicinis* (Brunfels' edition, Argentorati, 1531), p. 264, refers to Galen's preſcription of iron ſcoriæ, and under the article *de lapide magnetis*, p. 260, quotes Dioſcorides as follows: “Et uirtus huius lapidis eſt, ut quādo dantur in potu duo onoloſat ex eo cū melicrato, laxat humores groſſos.”

The original paſſage in Dioſcorides, *De Materia Medica*, ch. 147 (Spengel's edition of 1829) runs: Τοῦ δὲ μαγνήτου λίθου ἀριſτός ἐſτιν ὁ τὸν σίδηρον εὐχερῶς ἔλκων, καὶ τὴν χροάν κυανίζων, πυκνός τε καὶ οὐκ ἄγαν βαρύνς. Δύναμιν δὲ ἔχει πάχους ἀγωγὸν διδόμενος μετὰ μελικράτου τριωβόλου βάρους· ἐνιοὶ δὲ τοῦτον καίοντες ἀντὶ αἱματίου πιπράσκουσιν.”

In the Frankfurt edition of Dioſcorides, tranſlated by Ruellius (1543), the paſſage is:

“Magnes lapis optimus eſt, qui ferrum facile trahit, colore ad cœruleum uergente, denſus, nec admodum gravis. Datur cum aqua mulſa, trium obolorum pondere, ut craſſos humores eliciat. Sunt qui magnetem crematū pro hæmatite vendant. . . .”

In the *Scholia* of Joannes Lonicerus upon Dioſcorides *In Dioſcoridæ*

Anazarbei de re medica libros a Virgilio Marcello versos, Scholia nova, Ioanne Lonicero autore (Marburgi, 1543, p. 77), occurs the following:

"*De recremento ferri.* Cap. XLIX.

"*Σκωρία σιδήρου.* scoria vel recrementum ferri. Quæ per ignem à ferro et cupro fordes separantur ac reijciuntur, et ab aliis metallis *σκωρία* uocantur. Omnis scoria, maxime uero ferri exiccat. Acerrimo aceto maceravit Galenus ferri scoriam, ac deinde excocto, pharmacum efficax confecit ad purulentas quæ multo tempore uexatæ erant, aures, admirando spectantium effectū. Ardenti scoria uel recrementum *ἑλκυσμα*, inquit Galenus."

See also the *Enarrationes eruditissimæ* of Amatus Lusitanus (Venet., 1597), pp. 482 and 507, upon iron and the loadstone.

Page 36, line 27. Page 37, line 29. *eijcitur* for *ejicitur*.

Page 37, line 18. Page 37, line 22. *ut Cardanus philosophatur.*—Cardan's nonsense about the magnet feeding on iron is to be found in *De Subtilitate*, lib. vii. (Basil., 1611, p. 381).

Page 38, line 4. Page 38, line 7. *ferramenta . . . in usum navigantium.*—Compare Marke Ridley's *A Short Treatise of Magneticall Bodies and Motions* (Lond., 1613), p. a2 in the *Preface Magneticall*, where he speaks of the "iron-workes" used in building ships. The phraseology of Marke Ridley throws much light on the Latin terms used by Gilbert.

Page 38, line 36. Page 38, line 42. *vruntur*; changed in ink to *vrantur* in the folio of 1600; but *uruntur* appears in the editions of 1628 and 1633.

Page 39, line 12. Page 39, line 12. *utrumque*; altered in ink to *utrunque* in all copies of the folio edition of 1600.

Page 40, line 32. Page 40, line 33. *ad tantos labores exantlandos.*—Pumping, as it was in mining before the invention of the steam engine, may best be realized by examining the woodcuts in the *De re metallica* of Georgius Agricola (Basil., Froben, 1556).

Page 40, line 34. Page 40, line 36. *quingentas orgyas.*—Gilbert probably had in his mind the works of the Rörerbüchel, in the district of Kitzbühl, which in the sixteenth century had reached the depth of 3,107 feet. See Humboldt's *Cosmos* (Lond., 1860, vol. i., p. 149).

Page 43, line 34. Page 43, line 33. *glis.*—This word, here translated *grit*, does not appear to be classical Latin; it may mean *ooze* or *slime*.

Page 45, line 25. Page 45, line 26. *Motus igitur . . . quinque.* The five kinds of magnetic motions correspond in fact to the remaining sections of the book; as follows: *Coitio*, Book II.; *Directio*, Book III.; *Variatio*, Book IV.; *Declinatio*, Book V.; and *Reolutio*, Book VI.

Page 46, line 7. Page 46, line 8. *Jofrancus Offusius.*—The reference is to the treatise *De divina astrorum facultate* of Johannes Franciscus Offusius (Paris, 1570).

Page 47, line 15. Page 47, line 18. *Græci vocant ἡλέκτρον, quia ad se paleas trahit.* In this discussion of the names given to amber, Gilbert apparently conceives ἡλέκτρον to be derived from the verb ἑλκεῖν; which is manifestly a doubtful etymology. There has been much discussion amongst philologists as to the derivation of ἡλέκτρον or ἡλεκτρον, and its possible connection with the word ἡλέκτωρ. This discussion has been somewhat obscured by the circumstance that the Greek authors unquestionably used ἡλεκτρον (and the Latins their word *electrum*) in two different significations, some of them using these words to mean amber, others to mean a shining

metal, apparently of having qualities between those of gold and silver, and probably some sort of alloy. Schweigger, *Ueber das Elektron der Alten* (Greifswald, 1848), has argued that this metal was indeed no other than platinum: but his argument partakes too much of special pleading. Those who desire to follow the question of the derivation of ἤλεκτρον may consult the following authorities: J. M. Gessner, *De Eleetro Veterum* (Commentt. Soc. Reg. Scientt. Goetting., vol. iii., p. 67, 1753); Delaunay, *Mineralogie der Alten*, Part II., p. 125; Buttmann, *Mythologus* (Appendix I., *Ueber das Elektron*), Vol. II., p. 355, in which he adopts Gilbert's derivation from ἔλκειν; Beckmann, *Ursprung und Bedeutung des Bernsteinnamens Elektron* (Braunsberg, 1859); Th. Henri Martin, *Du Succin, de ses noms divers et de ses variétés suivant les anciens* (Mémoires de l'Académie des Inscriptions et Belles-lettres, Tome VI., 1^{re} série, 1^{re} partie, 1860); Martinus Scheins, *De Eleetro Veterum Metallico* (Inaugural dissertation, Berlin, 1871); F. A. Paley, *Gold Worship in relation to Sun Worship* (Contemporary Review, August, 1884). See also Curtius, *Grundzüge der griechischen Etymologie*, pp. 656-659. The net result of the disputations of scholars appears to be that ἤλεκτωρ (he who shines) is a masculine form to which there corresponds the neuter form ἤλεκτρον (that which shines). Stephanus admits the accentuation used by Gilbert, ἤλεκτρον, to be justified from the *Timæus* of Plato; see Note to p. 61.

Page 47, line 16. Page 47, line 19. ἄρπαξ *dicitur*, ἔ χρυσοφόρον.— With respect to the other names given to amber, M. Th. Henri Martin has written (see previous note) so admirable an account of them that it is impossible to better it. It is therefore given here entire, as follows:

“Le succin a reçu chez les anciens des noms très-divers. Sans parler du nom de λυγκούριον, *lyncurium*, qui peut-être ne lui appartient pas, comme nous le montrerons plus loin, il s'est nommé chez les Grecs le plus souvent ἤλεκτρον au neutre,¹ mais aussi ἤλεκτρος au masculin² et même au féminin,³ χρυσήλεκτρος,⁴ χρυσοφόρος,⁵ et peut-être, comme nous l'avons vu, χαλκολίθανον; plus tard σούχιον⁶ ou σουχίνος,⁷ et ἤλεκτριανός λίθος;⁸ plus tard encore βερενίκη, βερνίκη ou βερνίκη;⁹ il s'est nommé ἄρπαξ chez les Grecs établis en Syrie;¹⁰ chez les Latins *succinum*, *electrum*, et deux variétés, *chryseletrum* et *sualiterni-*

¹ Voyez Hérodote, III., 115; Platon, *Timée*, p. 80c; Aristote, *Météor.*, IV., 10; Théophraste, *Hist. des plantes*, IX., 18 (19), § 2; *Des pierres*, § 28 et 29; Diodore de Sic., V., 23; Strabon, IV., 6, n° 2, p. 202 (Casaubon); Dioscoride, *Mat. méd.*, I., 110; Plutarque, *Questions de table*, II., 7, § 1; *Questions platoniques*, VII., 1 et 7; Lucien, *Du succin et des cygnes*; le même, *De l'astrologie*, § 19; S. Clément, *Strom.* II., p. 370 (Paris, 1641, in-fol.); Alexandre d'Aphr., *Quest. phys. et mor.*, II., 23; Olympiodore, *Météor.*, I., 8, fol. 16, t. I., p. 197 (Ideler) et l'abréviateur d'Etienne de Byzance au mot Ἠλεκτρίδες.

² Voyez Sophocle, *Antigone*, v. 1038, et dans Eustathe, sur l'*Iliade*, II., 865; Elien, *Nat. des animaux*, IV., 46; Quintus de Smyrne, V., 623; Eustathe, sur la *Périégèse* de Denys, p. 142 (Bernhardy), et sur l'*Odyssée*, IV., 73; et Suidas au mot ὄαλη.

³ Voyez Alexandre, *Problèmes*, sect. 1, proœm., p. 4 (Ideler); Eustathe, sur l'*Odyssée*, IV., 73, et Tzetzes, *Chiliade* VI., 650.

⁴ Voyez Psellus, *Des pierres*, p. 36 (Bernard et Mauffac).

⁵ Voyez Dioscoride, *Mat. méd.*, I., 110.

⁶ Voyez S. Clément, *Strom.*, II., p. 370 (Paris, 1641, in-fol.). Il paraît distinguer l'un de l'autre τὸ σούχιον et τὸ ἤλεκτρον, probablement parce qu'il attribue à tort au métal ἤλεκτρον la propriété attractive du succin.

⁷ Voyez le faux Zoroastre, dans les *Géoponiques*, XV., 1, § 29.

⁸ Voyez le faux Zoroastre, au même endroit.

⁹ Voyez Eustathe, sur l'*Odyssée*, IV., 73; Tzetzes, *Chil.* VI., 650; Nicolas Myrepsè, *Antidotes*, ch. 327, et l'*Etymol. Gud.* au mot ἤλεκτρον. Comparez Saumaïse, *Exerc. plin.*, p. 778.

¹⁰ Voyez Plinè, XXXVII., 2, s. 11, n° 37.

cum ou *subalternicum*;¹ chez les Germains, *Glefs*;² chez les Scythes, *facrium*;³ chez les Egyptiens, *facal*;⁴ chez les Arabes, *karabé*⁵ ou *kahraba*;⁶ en persan, *kâruba*.⁷ Ce mot, qui appartient bien à la langue persane, y signifie *attirant la paille*, et par conséquent exprime l'attraction électrique, de même que le mot ἀρπαξ des Grecs de Syrie. En outre, le nom de *haur roumi* (*peuplier romain*) était donné par les Arabes, non-seulement à l'arbre dont ils croyaient que le succin était la gomme, mais au succin lui-même. *Haur roumi*, transformé en *aurum* par les traducteurs latins des auteurs arabes, et confondu mal à propos avec *ambar* ou *ambrum*, nom arabe latinisé de l'ambre gris, a produit le nom moderne d'*ambre*, nom commun à l'*ambre jaune* ou succin, qui est une résine fossile, et à l'*ambre gris*, concrétion odorante qui se forme dans les intestines des cachalots. On ne peut dire avec certitude si le nom de basse grécité βερνίκη est la source ou le dérivé de *Bern*, radical du nom allemand du succin (*Bernstein*). Quoi qu'il en soit, le mot βερνίκη a produit *vernix*, nom d'une gomme dans la basse latinité, d'où nous avons fait *vernix*.⁸

Page 47, line 17. Page 47, line 20. *Mauri vero Carabem appellant, quia solebant in sacrificijs, & deorum cultu ipsum libare. Carab enim significat offerre Arabicè; ita Carabe, res oblata; aut rapiens paleas, ut Scaliger ex Abohali citat, ex linguâ Arabicâ, vel Persicâ.*—The printed text, line 18, has "Non rapiens paleas," but in all copies of the folio of 1600, the "Non" has been altered in ink into "aut," possibly by Gilbert's own hand. Nevertheless the editions of 1628 and 1633 both read "Non." There appears to be no doubt that the origin of the word *Carabe*, or *Karabe*, as assigned by Scaliger, is substantially correct. As shown in the preceding note, Martin adopted this view. If any doubt should remain it will be removed by the following notes which are due to Mr. A. Houtum Schindler (member of the Institution of Electrical Engineers), of Terahan.

Reference is made to the magnetic and electric properties of stones in three early Persian lapidaries. There are three stones only mentioned, amber, loadstone, and garnet. The electric property of the diamond is not mentioned. The following extracts are from the *Tansûk nâmah*, by Nasîr ed dîn Tûfî, A.D. 1260. The two other treatises give the first extracts in the same words.

"*Kâhrubâ*, also *Kahrabâ* [Amber],

"Is yellow and transparent, and has its name from the property, which it possesses, of attracting small, dry pieces of straw or grass, after it has been rubbed with cloth and become warm. [Note. In Persian, *Kâh* = straw; *rubâ* = the robber, hence *Kâhrubâ* = the straw-robber.] Some consider it a mineral, and say that it is found in the Mediterranean and Caspian seas, floating on the surface, but this is not correct. The truth is that *Kâhrubâ*

¹ Voyez Pline, XXXVII., 2, s. 11-13, et Tacite, *Germanie*, ch. 45. La forme *subalternicum*, dans Pline (s. 11, n° 33), est donnée par le manuscrit de Bamberg et par M. Sillig (t. V., p. 390), au lieu de la forme *subalternicum* des éditions antérieures.

² Voyez Tacite et Pline, *l. c.*

³ Voyez Pline, XXXVII., 2, s. 11, n° 40, Comp. J. Grimm, *Gesch. der deutsch. Sprache*, Kap. x., p. 233 (Leipzig, 1848, in-8).

⁴ Pline, *l. c.*

⁵ Voyez Saumaïse, *De homon. hyles iatricæ*, c. 101, p. 162 (1689, in-fol.).

⁶ Voyez Sprengel, sur Dioscoride, t. II., pp. 390-391.

⁷ Voyez M. de Sacy, cité par Buttmann, *Mythologus*, t. II., pp. 362-363.

⁸ Voyez Saumaïse, *Ex. plin.*, p. 778. Il n'est pas probable que le mot βερνίκη ou βερηνίκη, nom du succin dans la grécité du moyen âge, soit lié étymologiquement avec le nom propre βερηνίκη, qui vient de l'adjectif macédonien βερηνικός pour φερηνικός.

is the gum of a tree, called jôz i rûmî [*i.e.*, roman nut; walnut?], and that most of it is brought from Rûm [here the Eastern Rome] and from the confines of Sclavonia and Russia. On account of its bright colour and transparency it is made into beads, rings, belt-buckles, &c. . . . &c.

"The properties of attraction and repulsion are possessed by other substances than loadstone, for instance, by amber and *bijâdah*,¹ which attract straws, feathers, etc., and of many other bodies, it can be said that they possess the power of attraction. There is also a stone which attracts gold; it has a pure yellow colour. There is also a stone which attracts silver from distances of three or two yards. There are also the stone which attracts tin, very hard, and smelling like asafœtida, the stone attracting hair, the stone attracting meat, etc., but, latterly, no one has seen these stones: no proof, however, that they do not exist."

Avicenna (Ibn Sinâ) gives the following under the heading of *Karabe* (see *Canona Medicinæ*, Giunta edition, Venet., 1608, lib. ii., cap. 371, p. 336):

"*Karabe* quid est? Gumma sicut fandaraca, tendens ad citrinitatem, & albedinem, & peruietatem, & quandoque declinat ad rubedinem, quæ attrahit paleas, & [fracturas] plantarum ad se, & propter hoc nominatur *Karabe*, scilicet rapiens paleas, persicè. . . . *Karabe* confert tremori cordis, quum bibitur ex eo medietas aurei cum aqua frigida, & prohibet sputum sanguinis valde. . . . Retinet vomitum, & prohibet materias malas a stomacho, & cum mastiche confortat stomachum. . . . Retinet fluxum sanguinis ex matrice, & ano, & fluxum ventris, & confert tenasmoni."

Scaliger in *De Subtilitate, Exercitatio* ciii., § 12, the passage referred to by Gilbert says: "*Succinum* apud Arabas uocatur, *Carabe*: quod princeps Aboali, rapiens paleas, interpretatur" (p. 163 *bis*, editio Lutetiæ, 1557).

Page 47, line 21. Page 47, line 25. *Succinum seu succum*.—Dioscorides regarded amber as the inspissated juice of the poplar tree. From the Frankfurt edition of 1543 (*De Medicinali materia, etc.*), edited by Ruellius, we have, liber i., p. 53:

Populus. Cap. XCIII.

" . . . Lachrymam populorum commemorant quæ in Padum amnem defluat, durari, ac coire in succinum, quod electrum vocant, alii chrysophorum. id attritu jucundum odorem spirat, et aurum colore imitatur. tritum potumque stomachi ventrisque fluxiones sistit."

To this Ruellius adds the commentary:

"*Succinum* seu succina gutta à succo dicta, Græcis ἤλεκτρον [sic], esse

¹ *Bijâdah* is classified by Muhammad B. Mansûr (A.D. 1470) and by Ibn al Mubârak (A.D. 1520) under "stones resembling ruby"; the Tanfûk nâmah describes it in a separate chapter. From the description it can be identified with the almandine garnet, and the method of cutting this stone *en cabochon*, with hollow back in order to display its colour better, is specially mentioned. The Tanfûk nâmah only incidentally refers to the electric property of the *bijâdah* in the chapter on loadstone, but the other two treatises specially refer to it in their description of the stone. The one has: "*Bijâdah*, if rubbed until warm, attracts straws and other light bodies just as amber does"; the other: "*Bijâdah*, if rubbed on the hair of the head, or on the beard, attracts straws." Surûri, the lexicographer, who compiled a dictionary in 1599, considers the *bijâdah* "a red ruby which possesses the property of attraction." Other dictionaries do not mention the attractive property, but some authors confound the stone with amber, calling it *Kâhrubâ*, the straw-robber. The *bijâdah* is not rubellite (red tourmaline) for it is described in the lapidaries as common, whereas rubellite (from Ceylon) has always been rare, and was unknown in Persia in the thirteenth century.

lachryma populi albæ, vel etiam nigræ quibusdam videtur, ab ejusdem arboris refina. Dioscoridi et Galeno dicta differens et *περυγοφόρος*, id est paleas trahens, quoque vocatur, quantum ei quoque Galenus tribuit li. 37, ca. 9. Succinum scribit à quibusdam pinei generis arboribus, ut gummi à cerasis excidere autumno, et largum mitti ex Germania septentrionali, et insulis maris Germanici. quod hodie nobis est compertissimum: ad hæc liquata igni valentiore, quia à frigido intensiore concrevit. pineam aperte olet, calidum primo gradu, siccum secundo, stomachum roborat, vomitum, nauseam arcet. cordis palpitationi prodest. pravorem humorum generationem prohibet.

"Germani weiß und gelbaugstein et breñstein.

"Galli ambra vocant: vulgo in corollis precariis frequens."

In the scholia of Johann Lonicer in his edition of Dioscorides, we find, lib. i., cap. xcvi., *De nigra Populo*:

"*αἰγέρος*, populus nigra. . . . idem electrum vel succinum *αἰγέρον* lachrymam esse adseverat [Paulus], cui præter vires quæ ab Dioscoride recensentur, tribuit etiam vim sistendi sanguinis, si tusum in potu sumatur. Avicennæ Charabe, ut colligitur ex Joanne Jacobo Manlio, est electrum hoc Dioscoridis, attestatur Brunfelsius. Lucianus planè nullum electrum apud Eridanum seu Padum inveniri tradit, quandoquidem ne populus quidem illa ab nautis ei demonstrari potuerit. Plinius rusticas transpadanas ex electro monilia gestare adfirmat, quum à Venetis primum agnoscere didicissent adversus nimirum vitia gutturis et tonsillarum. Num sit purgamentum maris, vel lachryma populi, vel pinus, vel ex radiis occidentis solis nascatur, vel ex montibus Sudinorum profluat, incertum etiam Erasmus Stella relinquit. Sudinas tamen Borussia opes esse constat."

Matthioli (in *P. A. Mattioli . . . Opera quæ extant omnia, hoc est Commentarii in vi libros P. Dioscoridis de materia medica*, Frankfurt, 1596, p. 133) comments on the suggestion of Galen that amber came from the *Populus alba*, and also comments on the Arabic, Greek, and Latin names of amber.

The poplar-myth is commemorated by Addison (in *Italy*) in the lines:

No interwoven reeds a garland made,
To hide his brows within the vulgar shade;
But poplar wreathes around his temples spread,
And tears of amber trickled down his head.

Amber is, however, assuredly not derived from any poplar tree: it comes from a species of pine long ago extinct, called by Göppert the *pinites succinifer*.

Gilbert does not go into the medicinal uses, real or fancied, that have been ascribed to amber in almost as great variety as to loadstone. Pliny mentions some of these in his *Natural Historie* (English version of 1601, p. 609):

"He [Callistratus] saith of this yellow Amber, that if it be worne about the necke in a collar, it cureth feavers, and healeth the diseases of the mouth, throat, and jawes: reduced into powder and tempered with honey and oile of roses, it is soveraigne for the infirmities of the eares. Stamped together with the best Atticke honey, it maketh a singular eyesalve for to help a dim sight: pulverized, and the powder thereof taken simply alone, or else drunke in water with Masticke, is soveraigne for the maladies of the stomacke."

Nicolaus Myrepsus (Recipe 951, *op. citat.*) gives a prescription for

dyfentery and diabetes confifting chiefly of "Electri vel fucci Nili (Nili succum appellant Arabes Karabem)."

Page 47, line 22. Page 47, line 26. *Sudauienfes seu Sudini*.—Cardan in *De Rerum Varietate*, lib. iii., cap. xv. (Editio Bafil., 1556, p. 152), fays of amber:

"Colligitur in quadam penè infula Sudinorum, qui nunc uocātur Brusci, in Prussia, nunc Borussia, juxta Veneticum finum, & sunt orientales oſtiis Viſtulæ fluuii: ubi triginta pagi huic muneri deſtinati ſunt," etc. He rejects the theory that it conſiſts of hardened gum.

There exiſts an enormous literature concerning Amber and the Pruſſian amber induſtry. Amongſt the earlieſt works (after Theophraſtus and Pliny) are thoſe of Aurifaber (*Bericht über Agtſtein oder Börnſtein*, Königsberg, 1551); Goebel (*De Succino, Libri duo, authore Severino Gabelio, Medico Doctore*, Regiomont., 1558); and Wigand (*Vera hiſtoria de Succino Borussia*, Jena, 1590). Later on Hartmann, P. J. (*Succini Pruſſici Phyſica et civilis Hiſtoria*, Francofurti, 1677); and the ſplendid folio of Nathaniel Sendel (*Hiſtoria Succinorum corpora aliena involventium*, Lipſiæ, 1742), with its wealth of plates illuſtrating amber ſpecimens, with the various included foſſil fauna and flora. Georgius Agricola (*De natura Foſſilium*, liber iv.), and Aldrovandi (*Muſæum Metallicum*, pp. 411-412) muſt alſo be mentioned. Bibliographies of the earlier literature are to be found in Hartmann (*op. citat.*), and in Daniel Gralath, *Elektriſche Bibliothek (Verſuche und Abhandlungen der Naturforſchenden Geſellſchaft in Danzig, Zweiter Theil*, pp. 537-539, Danzig and Leipzig, 1754). See alſo Karl Müllenhoff, *Deuſche Altertumskunde*, vol. i., Zweites Buch, pp. 211-224, Zinn und Bernſteinhandel (Berlin, 1870), and Humboldt's *Cosmos* (Bohn's edition, London, 1860, vol. ii., p. 493).

The ancient Greek myth according to which amber was the tears of the Heliades, ſhed on the banks of the river Eridanus over Phaethon, is not alluded to by Gilbert. It is narrated in well-known paſſages in Ovid and in Hyginus. Thoſe intereſted in the modern handling of the myth ſhould refer to Müllenhoff (*op. citat.*, pp. 217-223, der Bernſteinmythus), or to that delightful work *The Tears of the Heliades*, by W. Arnold Buffum (London, 1896).

Page 47, line 30. Page 47, line 36. *quare & muſcos . . . in fruſtulis quibusdam comprehenſos retinet*.—The occurrence of flies in amber was well known to the ancients. Pliny thus ſpeaks of it, book xxxvii., chap. iii. (p. 608 of P. Holland's tranſlation of 1601):

"That it doth deſtill and drop at the firſt very clear and liquid, it is evident by this argument, for that a man may ſee diuerſe things within, to wit, Piſmires, Gnats, and Lizards, which no doubt were entangled and ſtucke within it when it was greene and freſh, and ſo remain enclosed within as it waxed harder."

A locuſt embedded in amber is mentioned in the *Muſæum Septalianum* of Terzagus (Dertonæ, 1664).

Martial's epigram (*Epigrammata*, liber vi., 15) is well known:

Dum Phaethontea formica vagatur in umbra
Implicuit tenuem succina gutta feram.

See alſo Hermann (Daniel), *De rana et lacerta Succino Borussia inſitis*

(Cracov., 1580; a later edition, Rigæ, 1600). The great work on *inclusa* in amber is, however, that of Nathaniel Sendel. See the previous note.

Sir Thomas Browne must not be forgotten in this connexion. The *Pseudodoxia* (p. 64 of the second edition, 1650) says:

"Lastly, we will not omit what Bellabonus upon his own experiment writ from Dantzich unto Mellichius, as he hath left recorded in his chapter *De Succino*, that the bodies of Flies, Pismires and the like, which are said oft times to be included in Amber, are not reall but representative, as he discovered in severall pieces broke for that purpose. If so, the two famous Epigrams hereof in Martiall are but poetically, the Pismire of Brassavolus Imaginary, and Cardans Mousoleum for a flie, a meer phancy. But hereunto we know not how to assent, as having met with some whose reals made good their representments." See also Pope's *Epistle to Dr. Arbuthnot*, line 169.

Page 47, line 34. Page 47, line 40. *Commemorant antiqui quod succinum festucas et paleas attrahit.*—Pliny (book xxxvii., chap. ii., p. 606 of the English edition of 1601) thus narrates the point:

"Hee [*Niceas*] writeth also, that in Aegypt it [amber] is engendered. . . . Semblably in Syria, the women (saith hee) make wherves of it for their spindles, where they use to call it Harpax, because it will catch up leaves, straws, and fringes hanging to cloaths."

p. 608. "To come to the properties that Amber hath, If it bee well rubbed and chaufed betweene the fingers, the potentiall facultie that lieth within, is set on work, and brought into actual operation, whereby you shall see it to drawe chaffe strawes, drie leaves, yea, and thin rinds of the Linden or Tillet tree, after the same sort as loadstone draweth yron."

Page 47, line 36. Page 47, line 42. *Quod etiam facit Gagates lapis.*—The properties of Jet were well known to the mediæval writers. *Julius Solinus* writes in *De Mirabilibus*, chapter xxxiv., *Of Britaine* (English version of 1587 by A. Golding):

"Moreover to the intent to passe the large abundance of sundry mettals (whereof Britaine hath many rich mynes on all sides), Here is store of the stone called Geate, and y^e best kind of it. If ye demaund y^e beautie of it, it is a black Jewell: if the qualitie, it is of no weight: if the nature, it burneth in water, and goeth out in Oyle; if the power, rubbe it till it be warme, and it holdeth such things as are laide to it; as Amber doth. The Realme is partlie inhabited of barbarous people, who even frõ theyr childhoode haue shapen of divers beastes cunninglye impressed and incorporate in theyr bodyes, so that beeing engraved as it were in theyr bowels, as the man groweth, so growe the marks painted vpon him . . ."

Pliny describes it as follows (p. 589, English edition of 1601):

"The Geat, which otherwise we call Gagates, carrieth the name of a toune and river both in Lycia, called Gages: it is said also, that the sea casteth it up at a full tide or high water into the Island Leucola, where it is gathered within the space of twelve stadia, and no where else: blacke it is, plaine and even, of a hollow substance in manner of the pumish stone, not much differing from the nature of wood; light, brittle, and if it bee rubbed or bruised, of a strong flavour." (Book xxxvi., chap. xviii.)

In the Commentary of Joannes Ruellius upon Dioscorides, *Pedanii Dioscoridis Anazarbei de medicinali materia libri sex, Ioanne Ruellio Sueffionensi interprete* . . . (Frankfurt, 1543, fol., liber quintus, cap. xcii.) is the following description:

"In Gagatarum lapidum genere, præferendus qui celeriter accenditur, et odorem bituminis reddit. niger est plerunque, et squalidus, crustosus, per quam levis. Vis ei molliendi, et discutiendi. deprehendit fonticum morbum suffitus, recreatque uulvæ strangulationes. fugat serpentes nidore. podagricis medicaminibus, et a copis additur. In Cilicia nasci solet, qua influens amnis in mare effunditur, proxime oppidum quod Plagiopolis dicitur. vocatur autem et locus et amnis Gagas, in cujus faucibus ii lapides inveniuntur.

"Gagates lapis colore atro, Germanis Schwartzzer augstein, voce parum depravata, dicitur. odore dum uritur bituminis, siccatur, glutinat, digerit admotus, in corollis precariis et salinis frequens."

And in the *Scholia* upon Dioscorides of Joannes Lonicer (Marpurgi, 1643, cap. xcvi., p. 80) is the following :

"*De Gagate Lapide.* Ab natali solo, urbe nimirum Gagæ Lyciæ nomen habet. Galenus se flumen isthuc et lapidem non invenisse, etiam si naui parua totam Lyciam perlustravit: ait, se autem in caua Syria multos nigros lapides invenisse glebosos, qui igni impositi, exigua flammam gignerent. Meminit hujus Nicander in Theriacis nempe suffitum hujus abigere venenata."

There is also a good account of *Gagates* (and of *Succinum*) by Langius, *Epistola LXXV.*, p. 454, of the work *Epistolarum medicinalium volumen tripartitum* (Francofurti, 1589).

Page 47, line 39. Page 47, line 45. *Multi sunt authores moderni.*—The modern authors who raised Gilbert's wrath by ignorantly copying out all the old tales about amber, jet, and loadstone, instead of investigating the facts, were, as he says at the beginning of the chapter, some theologians, and some physicians. He seems to have taken a special dislike to Albertus Magnus, to Puteanus (Du Puys), and to Levinus Lemnius.

Page 47, line 39. Page 47, line 46. *Et gagate.*—The editions of 1628 and 1633 both read *ex gagate*.

Page 48, line 14. Page 48, line 16. *Nam non solum succinum, Et gagates (ut illi putant) allestant corpuscula.*—The list of bodies known to become electrical by friction was not quite so restricted as would appear from this passage. Five, if not six, other minerals had been named in addition to amber and jet.

(1.) *Lyncurium.* This stone, about which there has been more obscurity and confusion than about any other gem, is supposed by some writers to be the tourmaline, by others a jacinth, and by others a belemnite. The ancients supposed it to be produced from the urine of the lynx. The following is the account of Theophrastus, *Theophrastus's History of Stones. With an English Version . . .*, by "Sir" John Hill, London, 1774, p. 123, ch. xlix.-l. "There is some Workmanship required to bring the Emerald to its Lustre, for originally it is not so bright. It is, however, excellent in its Virtues, as is also the *Lapis Lyncurius*, which is likewise used for engraving Seals on, and is of a very solid Texture, as Stones are; it has also an attractive Power, like that of Amber, and is said to attract not only Straws and small pieces of Sticks, but even Copper and Iron, if they are beaten to thin pieces. This Diocles affirms. The *Lapis Lyncurius* is pellucid, and of a fire Colour." See also W. Watson in *Philos. Trans.*, 1759, L. i., p. 394, *Observations concerning the Lyncurium of the ancients.*

(2.) *Ruby.*

(3.) *Garnet.* The authority for both these is Pliny, *Nat. Hist.*, book xxxvii., chap. vii. (p. 617 of English edition of 1601).

"Over and besides, I find other sorts of Rubies different from those above-named; . . . which being chaufed in the Sun, or otherwise set in a heat by rubbing with the fingers, will draw unto them chaffe, strawes, threads, and leaves of paper. The common Grenat also of Carchedon or Carthage, is said to doe as much, although it be inferiour in price to the former."

(4.) *Jasper*. Affaytatus is the authority, in *Fortunii Affaitati Physici atque Theologi . . . Physicæ & Astronomicæ cōsiderationes* (Venet., 1549), where, on p. 20, he speaks of the magnet turning to the pole, likening it to the turning of a "palea ab Ambro vel Iaspide et hujuscemodi lapillis lucidis."

(5.) *Lychnis*. Pliny and St. Isidore speak of a certain stone *lychnis*, of a scarlet or flame colour, which, when warmed by the sun or between the fingers, attracts straws or leaves of papyrus. Pliny puts this stone amongst carbuncles, but it is much more probably *rubellite*, that is to say, red tourmaline.

(6.) *Diamond*. In spite of the confusion already noted, à propos of *adamas* (Note to p. 47), between loadstone and diamond, there seems to be one distinct record of an attractive effect having been observed with a rubbed diamond. This was recorded by Fracastorio, *De sympathia et antipathia rerum* (Giunta edition, Venice, MDLXXIII, chap. v., p. 60 *verso*), "cujus rei & illud esse signum potest, cum confricata quædā vt Succinum, & Adamas fortius furculos trahunt." And (on p. 62 *recto*); "nam si per similitudine (vt supra diximus) fit hæc attractio, cur magnes non potius magnetem trahit, q̃ ferrum, & ferrum non potius ad ferrum movetur, quàm ad magnetem? quæ nam affinitas est pilorum, & furculorum cum Electro, & Adamante? præsertim q̃ si cum Electro affines sunt, quomodo & cum Adamante affinitatem habebunt, qui dissimilis Electro est?" An incontestable case of the observation of the electrification of the diamond occurs in Gartias ab Horto. The first edition of his *Historia dei Semplici Aromati* was published at Goa in India in 1563. In chapter xlviii. on the Diamond, occur these words (p. 200 of the Venetian edition of 1616): "Questo si bene ho sperimentato io più volte, che due Diamanti perfetti fregati insieme, si vniscono di modo insieme, che non di leggiero li potrai separare. Et ho parimente veduto il Diamante dopo di esser ben riscaldato, tirare à se le festuche, non men, che si faccia l'elettro." See also Aldrovandi, *Musæum Metallicum* (Bonon., 1648, p. 947).

Levinus Lemnius also mentions the Diamond along with amber. See his *Occulta naturæ miracula* (English edition, London, 1658, p. 199).

Page 48, line 16. Page 48, line 18. *Iris gemma*.—The name *iris* was given, there can be little doubt, to clear six-sided prisms of rock-crystal (quartz), which, when held in the sun's beams, cast a crude spectrum of the colours of the rainbow. The following is the account of it given in Pliny, book xxxvii., chap. vii. (p. 623 of the English version of 1601):

" . . . there is a stone in name called Iris: digged out of the ground it is in a certaine Island of the red sea, distant from the city Berenice three score miles. For the most part it resembleth Crytall: which is the reason that some hath tearmed it the root of Crytall. But the cause why they call it Iris, is, That if the beames of the Sunne strike upon it directly within house, it doth send from it against the walls that bee neare, the very resemblance both in forme and also in colour of a rainebow; and eftsoones it will chaunge the same in much varietie, to the great admiration of them that behold it. For certain it is knowne, that six angles it hath in manner of the Crytall: but they say that some of them have their sides rugged, and the same

unequally angled: which if they be laid abroad against the Sunne in the open aire, do scatter the beames of the Sunne, which light upon them too and fro: also that others doe yeeld a brightnes from themselves, and thereby illuminat all that is about them. As for the diverse colours which they cast forth, it never happeneth but in a darke or shaddowie place: whereby a man may know, that the varietie of colours is not in the stone Iris, but commeth by the reverberation of the wals. But the best Iris is that which representeth the greatest circles upon the wall, and those which bee likest unto rainebowes indeed."

In the English translation of Solinus's *De Mirabilibus* (*The excellent and pleasant worke of Julius Solinus contayning the noble actions of humaine creatures, the secretes and providence of nature, the descriptions of countries . . . tr. by A. Golding, gent.*, Lond., 1587), chapter xv. on Arabia has the following:

"Hee findeth likewise the Iris in the Red sea, fixe cornered as the Crystall: which beeing touched with the Sunnebeames, casteth out of him a bryght reflexion of the ayre like the Raynebowe."

Iris is also mentioned by Albertus Magnus (*De mineralibus*, Venet., 1542, p. 189), by Marbodeus Gallus (*De lapidibus*, Par. 1531, p. 78), who describes it as "crystallo simulem sexangulam," by Lomatius (*Artes of curious Paintinge*, Haydocke's translation, Lond., 1598, p. 157), who says, ". . . the Sunne, which casting his beames vpon the *stone Iris*, causeth the *raine-bowe* to appeare therein . . .," and by "Sir" John Hill (*A General Natural History*, Lond., 1748, p. 179).

Figures of the Iris given by Aldrovandi in the *Musæum Metallicum* clearly depict crytals of quartz.

Page 48, line 16. Page 48, line 18. *Vincentina*, & *Bristolla* (*Anglica gemma siue fluor*). This is doubtless the same substance as the *Gemma Vincentij rupis* mentioned on p. 54, line 16 (p. 54, line 18, of English Version), and is nothing else than the so-called "Bristol diamond," a variety of dark quartz crytallized in small brilliant crytals upon a basis of hæmatite. To the work by Dr. Thomas Venner (Lond., 1650), entitled *Via Recta* or the *Bathes of Bathe*, there is added an appendix, *A Censure concerning the water of Saint Vincents Rocks neer Bristol* (*Urbs pulchra et Emporium celebre*), in which, at p. 376, occurs this passage: "This Water of Saint Vincents Rock is of a very pure, cleare, crytalline substance, answering to those crytalline Diamonds and transparent stones that are plentifully found in those Clifts."

In the *Fossils Arranged* of "Sir" John Hill (Lond., 1771), p. 123, is the following entry: "Black crystal. Small very hard heavy glossy. Perfectly black, opaque. Bristol (grottos, glafs)" referring to its use.

The name *Vincentina* is not known as occurring in any mineralogical book. Prof. H. A. Miers, F.R.S., writes concerning the passage: "*Anglica gemma siue fluor* seems to be a synonym for *Bristolla*, or possibly for *Vincentina et Bristolla*. Both quartz and fluor are found at Clifton. In that case *Vincentina* and *Bristolla* refer to these two minerals, and if so one would expect *Bristolla* to be the Bristol Diamond, and *Vincentina* to be the comparatively rare Fluor spar from that locality."

At the end of the edition of 1653 of Sir Hugh Plat's *Jewel House of Art and Nature*, is appended *A rare and excellent Discourse of Minerals, Stones, Gums, and Rosins; with the vertues and use thereof*, By D. B. Gent. Here, p. 218, we read:

"We have in England a stone or mineral called a Bristol stone (because

many are found thereabouts) which much resembles the Adamant or Diamond, which is brought out of Arabia and Cyprus; but as it is wanting of the same hardnesse, so falls it short of the like vertues."

Page 48, line 18. Page 48, line 19. *CrySTALLus*.—Rock-cryftal. Quartz. Pliny's account of it (Philemon Holland's version of 1601, p. 604) in book xxxvii., chap. ii., is:

"As touching Cryftall, it proceedeth of a contrarie caufe, namely of cold; for a liquor it is congealed by extreame froft in manner of yce; and for prooffe hereof, you fhall find cryftall in no place els but where the winter fnow is frozen hard: fo as we may boldly fay, it is verie yce and nothing elfe, whereupon the Greeks have give it the right name Cryftallos, *i.* Yce. . . . Thus much I dare my felfe avouch, that cryftall groweth within certaine rockes upon the Alps, and thefe fo fteepe and inaccessible, that for the moft part they are constrained to hang by ropes that fhall get it forth."

Page 48, line 18. Page 48, line 20. *Similes etiam attrahendi vires habere videntur vitrum . . . sulphur, mastix, & cera dura figillaris*. If, as fhown above, the electric powers of diamond and ruby had already been obferved, yet Gilbert was the firft beyond queftion to extend the lift of *electrics* beyond the clafs of precious ftones, and his difcovery that *glafs*, *fulphur*, and *fealing-wax* acted, when rubbed, like amber, was of capital importance. Though he did not purfue the difcovery into mechanical contrivances, he left the means of that extenfion to his followers. To Otto von Guericke we owe the application of fulphur to make the firft electrical machine out of a revolving globe; to Sir Ifaac Newton the fuggeltion of glafs as affording a more mechanical conftitution.

Electrical attraction by natural products other than amber after they have been rubbed muft have been obferved by the primitive races of mankind. Indeed Humboldt in his *Cosmos* (Lond., 1860, vol. i., p. 182) records a ftriking inftance:

"I obferved with aftonifhment, on the woody banks of the Orinoco, in the fports of the natives, that the excitement of electricity by friction was known to thefe favage races, who occupy the very loweft place in the fcale of humanity. Children may be feen to rub the dry, flat and fhining feeds or hulks of a trailing plant (probably a *Negretia*) until they are able to attract threads of cotton and pieces of bamboo cane."

Page 48, line 23. Page 48, line 25. *arsenicum*.—This is *orpiment*. See the *Dictionary of metallick words* at the end of Pettus's *Fleta Minor*.

Page 48, line 23. Page 48, line 26. *in convenienti cælo ficco*.—The obfervation that only in a dry climate do rock-falt, mica, and rock-alum act as electrics is alfo of capital importance. Compare page 56.

Page 48, line 27. Page 48, line 31. *Alliciunt hæc omnia non feftucas modò & paleas*.—Gilbert himfelf marks the importance of this difcovery by the large afterifk in the margin. The logical confequence was his invention of the firft *eleetrofcope*, the *verforium non magneticum*, made of any metal, figured on p. 49.

Page 48, line 34. Page 48, line 36. *quòd tantum fccas attrahat paleas, nec folia ocimi*.—This filly tale that bafil leaves were not attracted by amber arofe in the *Quæftiones Convivales* of Plutarch. It is repeated by Marbodeus and was quoted by Levinus Lemnius as true. Gilbert denounced it as nonfenfe. Cardan (*De Subtilitate*, Norimb., 1550, p. 132) had already contradicted the fable. "Trahit enim," he fays, "omnia levia, paleas, feftucas, ramenta

tenuia metallorum, & ocimi folia, perperam contradicente Theophrasto." Sir Thomas Browne specifically refuted it. "For if," he says, "the leaves thereof or dried stalks be stripped into small strawes, they arise unto Amber, Wax, and other Electricks, no otherwise then those of Wheat or Rye."

Page 48, line 34. Page 48, line 38. *Sed ut poteris manifestè experiri . . .* Gilbert's experimental discoveries in electricity may be summarized as follows:

1. The generalization of the class of *Electrics*.
2. The observation that damp weather hinders electrification.
3. The generalization that electrified bodies attract everything, including even metals, water, and oil.
4. The invention of the non-magnetic *versorium* or electroscope.
5. The observation that merely warming amber does not electrify it.
6. The recognition of a definite class of *non-electrics*.
7. The observation that certain electrics do not attract if roasted or burnt.
8. That certain electrics when softened by heat lose their power.
9. That the electric effluvia are stopped by the interposition of a sheet of paper or a piece of linen, or by moist air blown from the mouth.
10. That glowing bodies, such as a live coal, brought near excited amber discharge its power.
11. That the heat of the sun, even when concentrated by a burning mirror, confers no vigour on the amber, but dissipates the effluvia.
12. That sulphur and shell-lac when aflame are not electric.
13. That polish is not essential for an electric.
14. That the electric attracts bodies themselves, not the intervening air.
15. That flame is not attracted.
16. That flame destroys the electrical effluvia.
17. That during south winds and in damp weather, glass and crystal, which collect moisture on their surface, are electrically more interfered with than amber, jet and sulphur, which do not so easily take up moisture on their surfaces.
18. That pure oil does not hinder production of electrification or exercise of attraction.
19. That smoke is electrically attracted, unless too rare.
20. That the attraction by an electric is in a straight line toward it.

Page 48, line 35. Page 48, line 39. *quæ sunt illæ materiæ.*—Gilbert's list of electrics should be compared with those given subsequently by Cabeus (1629), by Sir Thomas Browne (1646), and by Bacon. The last-named list occurs in his *Physiological Remains*, published posthumously in 1679; it contains nothing new. Sir Thomas Browne's list is given in the following passage, which is interesting as using for the first time in the English language the noun *Electricities*:

"Many stones also both precious and vulgar, although terse and smooth, have not this power attractive; as Emeralds, Pearle, Jaspis, Corneleans, Agathe, Heliotropes, Marble, Alabaster, Touchstone, Flint and Bezoar. Glasse attracts but weakly though cleere, some slick stones and thick glasses indifferently: Arsenic but weakly, so likewise glasse of Antimony, but Crocus Metallorum not at all. Saltes generally but weakly, as Sal Gemma, Alum, and also Talke, nor very discoverably by any friction: but if gently warmed at the fire, and wiped with a dry cloth, they will better discover their Electricities." (*Pseudodoxia Epidemica*, p. 79.)

In the *Philosophical Transactions*, vol. xx., p. 384, is *A Catalogue of Electrical Bodies* by the late Dr. Rob. Plot. It begins "Non solum succinum," and ends "alumen rupeum," being identical with Gilbert's list except that he calls "Vincentina & Bristolla" by the name "Pseudodamas Bristolienfis."

Page 49, line 25. Page 49, line 30. *non dissimili modo.*—The *modus*

operandi of the electrical attractions was a subject of much discussion; see Cardan, *op. citat.*

Page 51, line 2. Page 51, line 1. *appellunt*.—This appears to be a misprint for *appelluntur*.

Page 51, line 22. Page 51, line 23. *smiris*.—Emery. This substance is mentioned on p. 22 as a magnetic body.

Page 52, line 1. Page 51, line 46. *gemmæ . . . ut Crystallus, quæ ex limpidâ concreuit*. See the note to p. 48.

Page 52, line 30. Page 52, line 32. *ammoniacum*.—Ammoniacum, or Gutta Ammoniaca, is described by Dioscorides as being the juice of a ferula grown in Africa, resembling galbanum, and used for incense.

"*Ammoniack* is a kind of Gum like Frankincense; it grows in Lybia, where *Ammon's* Temple was." Sir Hugh Plat's *Jewel House of Art and Nature* (Ed. 1653, p. 223).

Page 52, line 38. Page 52, line 41. *duæ propositæ sunt causæ . . . materia & forma*.—Gilbert had imbibed the schoolmen's ideas as to the relations of matter and form. He had discovered and noted that in the magnetic attractions there was always a verticity, and that in the electrical attractions the rubbed electrical body had no verticity. To account for these differences he drew the inference that since (as he had satisfied himself) the magnetic actions were due to *form*, that is to say to something immaterial—to an "imponderable" as in the subsequent age it was called—the electrical actions must necessarily be due to *matter*. He therefore put forward his idea that a substance to be an electric must necessarily consist of a concreted humour which is partially resolved into an effluvium by attrition. His discoveries that electric actions would not pass through flame, whilst magnetic actions would, and that electric actions could be screened off by interposing the thinnest layer of fabric such as sarcenet, whilst magnetic actions would penetrate thick slabs of every material except iron only, doubtless confirmed him in attributing the electric forces to the presence of these effluvia. See also p. 65. There arose a fashion, which lasted over a century, for ascribing to "humours," or "fluids," or "effluvia," physical effects which could not otherwise be accounted for. Boyle's tracts of the years 1673 and 1674 on "effluvia," their "determinate nature," their "strange subtilty," and their "great efficacy," are examples.

Page 53, line 9. Page 53, line 11. *Magnes vero . . .*—This passage from line 9 to line 24 states very clearly the differences to be observed between the magnetical and the electrical attractions.

Page 53, line 36. Page 53, line 41. *succino calefacto*.—Ed. 1633 reads *succinum*, in error.

Page 54, line 9. Page 54, line 11. *Plutarchus . . . in quæstionibus Platoniciis*.—The following Latin version of the paragraph in *Quæstio sexta* is taken from the bilingual edition published at Venice in 1552, p. 17 verso, liber vii., cap. 7 (or, *Quæstio Septima* in Ed. Didot, p. 1230).

"Electrum uero quæ apposita sunt, nequaquam trahit, quem admodum nec lapis ille, qui fideritis nuncupatur, nec quicquā à seipso ad ea quæ in propinquo sunt, extrinsecus affilit. Verum lapis magnes effluxiones quasdam tum graves, tum etiam spiritales emittit, quibus aer continuatus & iunctus repellitur. Is deinceps alium sibi proximum impellit, qui in orbem circum actus, atque ad inanem locum rediens, ut ferrum secum rapit & trahit. At Electrum uim quandam flammæ similem & spiritalem continet, quam quidem

tritu summæ partis, quo aperiuntur meatus, foras eijcit. Nam leuissima corpuscula & aridissima quæ propè sunt, sua tenuitate atque imbecillitate ad seipsum ducit & rapit, cum non sit adeo ualens, nec tantum habeat ponderis & momenti ad expellendam aeris copiam, ut maiora corpora more Magnetis superare possit & uincere."

Page 54, line 16. Page 54, line 18. *Gemma Vincentij rupis*.—See the note to p. 48 *supra*, where the name *Vincentina* occurs.

Page 54, line 30. Page 54, line 35. *orobi*.—The editions of 1628 and 1633 read *oribi*.

Page 55, line 34. Page 55, line 42. *in euacuati*.—The editions of 1628 and 1633 read *inevacuati*.

Page 58, line 21. Page 58, line 25. *assurgentem vndam . . . declinat ab F*.—These words are wanting in the Stettin editions.

Page 59, line 9. Page 59, line 9. *fluore*.—This word is conjectured to be a misprint for *fluxu*, but it stands in all editions.

Page 59, line 22. Page 59, line 25. *Ruunt ad electria*.—This appears to be a slip for *electrica*, which is the reading of the editions of 1628 and 1633.

Page 60, line 7. Page 60, line 9. *tanq̄ materiales radij*.—The suggestion here of material rays as the *modus operandi* of electric forces seems to foreshadow the notion of electric lines of force.

Page 60, line 10. Page 60, line 12. *Differentia inter magnetica & electrica*.—Though Gilbert was the first systematically to explore the differences that exist between the magnetic attraction of iron and the electric attraction of all light substances, the point had not passed unheeded, for we find St. Augustine, in the *De Civitate Dei*, liber xxi., cap. 6, raising the question why the loadstone which attracts iron should refuse to move straws. The many analogies between electric and magnetic phenomena had led many experimenters to speculate on the possibility of some connexion between electricity and magnetism. See, for example, Tiberius Cavallo, *A Treatise on Magnetism*, London, 1787, p. 126. Also the three volumes of J. H. van Swinden, *Recueil de Mémoires sur l'Analogie de l'Électricité et du Magnétisme*, La Haye, 1784. Aepinus wrote a treatise on the subject, entitled *De Similitudine vis electricæ et magneticæ* (Petropolis, 1758). This was, of course, long prior to the discovery, by Oersted, in 1820, of the real connexion between magnetism and the electric current.

Page 60, line 25. Page 60, line 31. *Coitionem dicimus, non attractionem*.—See the remarks, at the outset of these Notes, on Gilbert's definitions of words.

Page 60, line 33. Page 61, line 1. *Orpheus in suis carminibus*.—This passage is in the chapter Λιθικά of Orpheus, verses 301 to 327. See Note to p. 11, line 19.

Page 61, line 15. Page 61, line 19. *Platonis in Timæo opinio*.—The passage runs (edition Didot, vol. ii., p. 240, or Stephanus, p. 80, C.):

Καὶ δὴ καὶ τὰ τῶν ὑδάτων πάντα ρεύματα ἔτι δὲ τὰ τῶν κεραυνῶν πτώματα καὶ τὰ θαυμαζόμενα ἡλέκτρων περὶ τῆς ἑλξεως καὶ τῶν Ἡρακλείων λίθων, πάντων τούτων ὁλκὴ μὲν οὐκ ἔστιν οὐδένι ποτε, τὸ δὲ κενὸν εἶναι μηδὲν περιωθεῖν τε αὐτὰ ταῦτα εἰς ἄλλα, τό τε διακρινόμενα καὶ συγκρινόμενα πρὸς τὴν αὐτῶν διαμεμβρόμενα ἔδραν ἕκαστα εἶναι πάντα, τούτοις τοῖς παθήμασι πρὸς ἄλλα συμπλεχθεῖσι τε θαυματουργημένα τῇ κατὰ τρόπον ζητοῦντι φανήσεται.

Page 61, line 30. Page 61, line 38. The English version of the lines of Lucretius is from Busby's translation.

Page 62, line 5. Page 62, line 7. *Iohannes Costæus Laudensis.*—Joannes Costa, of Lodi, edited Galen and Avicenna. He also wrote a *De universali stirpium Natura* (Aug. Taurin., 1578).

Page 63, line 3. Page 63, line 4. *Cornelius Gemma* 10. *Cosmocrit.*—This refers to the work *De Naturæ Divinis Characteris . . . Libri ii. Auctore D. Corn. Gemma* (Antv., 1575, lib. i., cap. vii., p. 123).

“Certè vt à magnete infensiles radij ferrum ad se attrahunt, ab echineide paruo pisciculo sistuntur plena nauigia, à catoblepa spiritu non homines solum, sed & alta serpentum genera interimuntur, & saxa dehiscunt.”

See also Kircher's *Magneticum Naturæ Regnum* (Amsterdam, 1667, p. 172), Sectio iv., cap. iii., De Magnete Navium, quæ Remora seu Echeneis dicitur. See the note to p. 7, line 21.

Page 63, line 6. Page 63, line 7. *Guilielmus Puteanus.*—Puteanus (Du Puys) wrote a work *De Medicamentorum quomodocunque Purgantium Facultatibus*, Libri ii. (Lugd., 1552), in which he talks vaguely about the substantial “form” of the magnet, and quotes Aristotle and Galen.

Page 63, line 21. Page 63, line 25. *Baptistæ Portæ.*—The passage in the translation is quoted from the English version of 1658, pp. 191, 192.

Page 64, line 4. Page 64, line 9. *Eruditè magis Scaliger.*—Gilbert pokes fun at Scaliger, whose “erudite” guess (that the motion of iron to the magnet was that of the offspring toward the parent) is to be found in his book *De Subtilitate, ad Cardanum, Exercitatio CII.* (Lutetiæ, 1557, p. 156 bis).

Page 64, line 7. Page 64, line 11. *Diuus Thomas.*—On p. 3 Gilbert had already spoken of St. Thomas Aquinas as a man of intellect who would have added more about the magnet had he been more conversant with experiments. The passage here quoted is from the middle of Liber vii. of his commentaries on the *de Physica* of Aristotle, *Expositio Diui Thome Aquinatis Doctoris Angelici super octo libros Physicorum Aristotelis*, etc. (Venice, Giunta edition, 1539, p. 96 verso, col. 2).

Page 64, line 16. Page 64, line 24. *Cardinalis etiam Cusanus.*—Cardinal de Cusa (Nicolas Khrypffs) wrote a set of dialogues on Statics, *Nicolai Cusani de staticis experimentis dialogus* (1550), of which an English version appeared in London in 1650 with the title, *The Idiot in four books; the first and second of wisdom, the third of the minde, the fourth of statick experiments. By the famous and learned C. Cusanus.* In the fourth book of *statick Experiments, Or experiments of the Ballance*, occurs (p. 186) the following:

“Orat. Tell me, if thou hast any device whereby the vertues of stones may be weighed.

“Id. I thinke the vertue of the Load-stone might be weighed, if putting some Iron in one scale, and a Load-stone in the other, untill the ballance were even, then taking away the Load-stone, and some other thing of the same weight being put into the scale, the Load-stone were holden over the Iron, so that that scale wou'd begin to rise; by reason of the Load-stones attraction of the Iron, then take out some of the weight of the other scale, untill the scale wherein the iron is, doe sinke againe to the æquilibrium, or equality still holding the Load-stone unmovable as it was; I beleeeve that by weight of what was taken out of the contrary scale, one might come proportionably to the weight of the vertue or power of the Load-stone. And in like manner, the vertue of a Diamond, might be found hereby, because

they say it hinders the Load-stone from drawing of Iron; and so other vertues of other stones, consideration, being alwayes had of the greatnesse of the bodyes, because in a greater body, there is a greater power and vertue."

In the 1588 edition of Baptista Porta's *Magiæ Naturalis Libri xx.*, in lib. vii., cap. xviii., occurs the description of the use of the balance to which Gilbert refers.

Page 67, line 21. Page 67, line 22. *aëris rigore*.—All editions read thus, but the sense seems to require *frigore*.

Page 67, line 27. Page 67, line 31. *Fracastorius*.—See his *De Sympathia*, lib. i., cap. 5 (Giunta edition, 1574, p. 60).

Page 68, line 5. Page 68, line 6. *Thaletis Milesij*.—See the note to p. 11, line 26.

Page 68, line 30. Page 68, line 35. *Ita coitio magnetica actus est magnetis, & ferri, non actio unius*.—See the introductory remarks to these notes. There is a passage in Scaliger's *De Subtilitate ad Cardanum* (Exercit. CII., cap. 5, p. 156 *op. citat.*) which may be compared with Gilbert's for its use of Greek terms: "Nā cū uita dicatur actus animæ, acceptus est abs te actus pro actione. Sed actus ille est ἐντελέχεια, nō autem ἔργον. At Magnetis attractio est ἔργον, non autē ἐντελέχεια." To which Gilbert retorts: "non actio unius, utriusque ἐντελέχεια; non ἔργον, συνεντελέχεια et conactus potius quam sympathia." He returns on p. 70 to the attack on Scaliger's metaphysical notions. There is a parallel passage in the *Epitome Naturalis Scientiæ* of Daniel Sennert (Oxonæ, 1664), in the chapter *De Motu*.

Page 71, line 4. Page 71, line 8. *ut in 8. physicorum Themistius existimat*.—See *Omnia Themistii Opera* (Aldine edition, 1533, p. 63), Book 8 of his Paraphrase on Aristotle's *Physica*.

Page 71, line 9. Page 71, line 14. *Quod verò Fracastorius*.—*Op. citat.*, lib. i., cap. 7, p. 62 *verso*.

Page 73, line 2. Page 73, line 2. *si A borealis*.—The editions of 1628 and 1633 omit the twelve words next following.

Page 73, line 9. Page 73, line 11. *ex minera*.—*Minera* is not a recognized word, even in late Latin. It occurs again, p. 97, line 12.

Page 77, line 2. Page 77, line 2. *multo magis*.—This is an *à fortiori* argument. It is interesting to find Gilbert comparing the velocity of propagation of magnetic forces in space with the velocity of light. The parallel is completed in line 13 by the consideration that as the rays of light require to fall upon an object in order that they may become visible, so the magnetic forces require a magnetic object in order to render their presence sensible.

Page 78, line 14. Page 78, line 16. *Orbem terrarum distinguunt*.—The editions of 1628 and 1633 here add a figure of a globe marked with meridians and parallels of latitude, but with an erroneous versorium pointing to the south. These editions also both read *existentiam* for the word *existentium* in line 20.

Page 83, line 5. Page 83, line 5. *magnes longior maiora pondera ferri attollit*.—Gilbert discovered the advantage, for an equal mass of loadstone, of an elongated shape. It is now well known that the specific amount of magnetism retained by elongated forms exceeds that in a short piece of the same material subjected to equal magnetizing forces.

Page 83, line 24. Page 83, line 28. *Non obstant crassa tabulata*.—Gilbert has several times referred (*e.g.*, on p. 77) to the way in which magnetic forces penetrate solid bodies. The experimental investigation in this chapter

is the more interesting because it shows that Gilbert clearly perceived the shielding action of iron to be due to iron conducting aside or diverting the magnetic forces.

Page 85, line 26. Page 85, line 31. *non convenient.*—The editions of 1628 and 1633 both read *et convenient.*

Page 86, line 3. Page 86, line 3. *illud quod exhalat.*—Literally, *that which exhales*, in the sense of that which escapes: but in modern English the verb exhale in the active voice is now not used of the substance that escapes, but is used of the thing which emits it. It must therefore be rendered *that which is exhaled* (i.e., breathed out).

Page 86, line 13. Page 86, line 15. *Ita tota interposita moles terrestris.*—Gilbert's notion that the gravitational force of the moon in producing the tides acts *through* the substance of the earth may seem curiously expressed. But the underlying contention is essentially true to-day. The force of gravity is not cut off or screened off by the interposition of other masses. A recent investigation by Professor Poynting, F.R.S., has shown that so far as all evidence goes all bodies, even the densest, are transparent with respect to gravitational forces.

Page 86, line 18. Page 86, line 20. *Sed de æstus ratione aliàs.*—There is no further discussion of the tides in *De Magnete*. But a short account is to be found in Gilbert's posthumous work *De Mundo nostro Sublunari Philosophia nova* (Amsterdam, Elzevir, 1651), in Lib. v., the part which in the manuscript was left in English, and was turned into Latin by his brother. It comprises about fifteen quarto pages, from Cap. X. to Cap. XIX. inclusive, beginning with a characteristic diatribe against Taftner, Levinus Lemnius, and Scaliger. But in assigning causes he himself goes wide of the mark. Proceeding by a process of elimination he first shows that the moon's light cannot be the cause that impels the tides. "Luna," he says, "non radio, non lumine, maria impellit. quomodo igitur? Sane corporum conspiratione, atque (ut similitudine rem exponam) Magnetica attractione." This cryptic utterance he proceeds to explain by a diagram, and adds: "Quare Luna non tam attrahit mare, quàm humorem & spiritum subterraneum; nec plus resistit interposita terra, quàm mensa, aut quicquam aliud densum, aut crassum, magnetis viribus."

Page 87, line 7. Page 87, line 9. *armatura.*—Here this means the cap or snout of iron with which the loadstone was armed. This is apparently the first use of the term in this sense.

In the *Dialogues of Galileo* (p. 369 of Salusbury's *Mathematical Collections*, Dialogue iii.), Sagredus and Salviatus discuss the arming of the loadstone, and the increased lifting power conferred by adding an iron cap. Salviatus mentions a loadstone in the Florentine Academy which, unarmed, weighed six ounces, lifting only two ounces, but which when armed took up 160 ounces. Whereupon Galileo makes Salviatus say: "I extreamly praise, admire, and envy this Authour, for that a conceit so stupendious should come into his minde. . . . I think him [i.e., Gilbert] moreover worthy of extraordinary applause for the many new and true Observations that he made, to the disgrace of so many fabulous Authours, that write not only what they do not know, but whatever they hear spoken by the foolish vulgar, never seeking to assure themselves of the same by experience, perhaps, because they are unwilling to diminish the bulk of their Books."

Page 87, line 12. Page 87, line 15. The reference to *lib. 3* is

a misprint for *lib.* 2. It is corrected in the edition of 1633, but not in that of 1628.

Page 87, line 17. Page 87, line 21. *conactu*.—The editions of 1628 and 1633 read *conatu*.

Page 88, line 2. Page 88, line 3. *Coitio verò non fortior*.—This heading to chap. xix., taken with the seven lines that follow, and the contrast drawn between *unitio* and *coitio*, throw much light on the fundamental sense attached by Gilbert to the term *coitio*. It is here clearly used in the sense of *mutual tendency toward union*. Note also the contrasted use in chap. xx. of the verbs *cohære* and *adhære*. Adhærence connotes a one-sided force (an impossibility in physics), cohærence a mutual force.

Page 90, line 9. Page 90, line 9. *nempè ut alter polus maius pondus arripiat*.—This acute observation is even now not as well known as it ought to be. Only so recently as 1861 Siemens patented the device of fastening a mass of iron to one end of an electromagnet in order to increase the power of the other end. The fact, so far as it relates to permanent magnets was known to Servington Savery. See *Philos. Transactions*, 1729, p. 295.

Page 92, line 3. Page 92, line 4. *Suspendit in aëre ferrum Baptista Porta*.—Porta's experiment is thus described (*Natural Magick*, London, 1658, p. 204): "*Petrus Pellegrinus* saith, he shewed in another work how that might be done: but that work is not to be found. Why I think it extream hard, I shall say afterwards. But I say it may be done, because I have now done it, to hold it fast by an invisible band, to hang in the air; onely so, that it be bound with a small thread beneath, that it may not rise higher: and then striving to catch hold of the stone above, it will hang in the air, and tremble and wag itself."

Page 97, line 29. Page 97, line 33. *Sed quæri potest . . .*—The question here raised by Gilbert is whether the lifting-power of magnets of equal quality is proportional to their weight. If a stone weighing a drachm will lift a drachm, would a stone that weighs an ounce lift an ounce? Gilbert erroneously answers that this is so, and that the lifting-power of a loadstone, whether armed or unarmed, is proportional to its mass.

The true law of the tractive force or lifting-power of magnets was first given in 1729 by James Hamilton (afterwards Earl of Abercorn) in a work entitled *Calculations and Tables Relating to the Attractive Virtue of Loadstones . . . Printed [at London?] in the Year 1729*. (See also a paper in the *Philos. Transactions*, 1729-30, vol. xxxvi., p. 245). This work begins thus:

"The Principle upon which these Tables are formed, is this: That if Two *Loadstones* are perfectly Homogeneous, that is, if their Matter be of the same Specifick Gravity, and of the same Virtue in all Parts of one Stone, as in the other; and that Like Parts of their Surfaces are Cap'd or Arm'd with Iron; then the Weights they sustain will be as the Squares of the Cube Roots of the Weights of the *Loadstones*; that is, as their Surfaces."

Upon lifting-power see also D. Bernoulli, *Acta Helvetica*, iii., p. 223, 1758; P. W. Haecker, *Zur Theorie des Magnetismus*, Nürnberg, 1856; Van der Willigen, *Arch. du Musée Teyler*, vol. iv., Haarlem, 1878; S. P. Thompson, *Philos. Magazine*, July, 1888.

In the book of James Hamilton, p. 5, he mentions a small terrella weighing 139 English grains, which would sustain no less than 23,760 grains, and was valued at £21 13s. 10 $\frac{3}{4}$ d.

In the *Musæum Septalianum* of Terzagus (Dertonæ, 1664, p. 42) is mentioned a loadstone weighing twelve ounces which would lift sixty pounds of iron.

Sir Isaac Newton had a loadstone weighing 3 grains, which he wore in a ring. It would lift 746 grains.

Thomson's *British Annual*, 1837, p. 354, gives the following reference: "In the *Records of General Science*, vol. iii., p. 272, there is an interesting description of a very powerful magnet which was sent from Virginia in 1776 by the celebrated Dr. Franklin to Professor Anderson, of Glasgow. It is now in the possession of Mr. Crichton. It weighs $2\frac{1}{2}$ grains, and is capable of supporting a load of 783 grains, which is equivalent to 313 times its own weight."

Page 99, line 10. Page 99, line 11. *Manifestum est*.—In this, as in many other passages, Gilbert uses this expression in the sense that *it is demonstrable*, rather than meaning that *it is obvious*: for the fact here described is one that is not at all self-evident, but one which would become plain when the experiment had been tried. For other instances of this use of *manifestum* see pages 144, line 20; 158, line 19; 162, line 10.

Page 100, line 20. Page 100, line 24. *si per impedimēta . . . pervenire possunt*.—All editions agree in this reading, but the sense undoubtedly requires *non possint*. Compare p. 91, line 21.

Page 102, line 4. Page 102, line 4. *capite 4*.—This is a misprint for *capite 40*, and is retained in the later editions. In the quotation from Baptista Porta, where the English version of 1658 is adhered to, the words "& deturbat eam" have been omitted by the translator.

Page 107, line 16. Page 107, line 18. *Cardanus scribit*.—The alleged perpetual motion machine is mentioned in *De rerum varietate*, lib. 9, cap. xlviii. (Basil., 1581, p. 641). See also the Note to p. 223. For Peregrinus and for Taifnier, see the note to p. 5, lines 8 and 12.

Page 107, line 19. Page 107, line 21. *Antonij de Fantis*.—His work is: *Tabula generalis scotice subtilitatis octo Sectionibus uniuersam Doctōris Subtilis Peritiā cōplectēs: ab excellentissimo doctore Antonio de Fātis taruifino edita . . .* Lugd., 1530.

Page 108, line 26. Page 108, line 31. *Cusani in staticis*.—See the note to p. 64, line 16.

Page 108, line 33. Page 108, line 41. *Languidi . . . tardiùs acquiescunt*.—The editions of 1628 and 1633 omit these seven words.

Page 109, line 11. Page 109, line 13. *halinitro*.—Either native carbonate of soda or native carbonate of potash might be meant, but not saltpetre. Scaliger, in his *De Subtilitate ad Cardanum* (Lutet., 1557, p. 164), *Exercitatio CIII.*, 15, under the title, *Nitrum non est Salpetræ*, says: "More tuo te, tuaque confundis. Salpetræ inter salis fossilis ponis hîc. Mox Halinitrum inter salis, & nitri naturam, speciem obtinere."

"*Sal nitrum* is salt which is boiled out of the earth, especially fat earth, as in stables, or any place of excrements." (*A Chymicall Dictionary explaining Hard Places and Words met withall in the Writings of Paracelsus* . . ., Lond., 1650.)

Page 109, line 20. Page 109, line 23. *arte ioculatoriâ*.—Edition 1628, *joculatoriâ*; edition 1633, *jaculatoriâ*.

Page 110, line 11. Page 110, line 12. *qualis fuit Antonij denarius*.—The Elizabethan version of Pliny (book xxxiii., ch. ix., p. 479) runs thus:

"To come now unto those that counterfeit money. *Antonius* whiles hee was one of the three usurping Triumvirs, mixed yron with the Romane silver denier. He tempered it also with the brazen coine, and so sent abroad false and counterfeit money."

Georgius Agricola (*De Natura Fossilium*, p. 646) says:

"Sed ea fraus capitalis est, non aliter ac eorum qui adulterinas monetas cudunt, argento miscentes multam plumbi candidi portionem, aut etiam ferri, qualis fuit Antonii denarius, ut Plinius memoriæ tradidit. Nunc dicam de candido plumbo, nam majoris pretii est quàm aes. In quod plumbum album, inquit Plinius, addita aeris tertia portione candidi adulteratur stannum."

Page 111, line 3. Page 111, line 3. *Meminerunt Chatochitis lapis Plinius, atque Iulius Solinus.*—The passage in Pliny (English version of 1601, book xxxvii., ch. x., p. 625) runs:

"Catochitis is a stone proper unto the Island Corfica: in bignesse it exceedeth ordinarie pretious stones: a wonderfull stone, if all be true that is reported thereof, and namely, That if a man lay his hand thereon, it will hold it fast in manner of a glewie gum."

Page 111, line 7. Page 111, line 7. *Sagda vel Sagdo.*—Albertus Magnus in *De Mineralibus* (Venet., 1542, p. 202) says:

"Sarda quem alij dicunt Sardo lapis est qui se habet ad tabulas ligni sicut magnes ad ferrū, et ideo adhæret ita fortiter tabulis nauium quòd euelli nō possit, nisi abscindatur cum ipso ea pars tabulæ cui inhæserit, est autē in colore purissimus nitens."

And Pliny (*op. citat.*, p. 629):

"Sagda is a stone, which the Chaldeans find sticking to ships, and they say it is greene as Porrets or Leekes."

Page 111, line 8. Page 111, line 8. *Euace.*—Evax, king of the Arabs, is said to have written to Nero a treatise on the names, colours, and properties of stones. See the note on Marbodæus, p. 7, line 20.

Page 113, line 14. Page 113, line 19. *repulsus sit.* The words read thus in all editions, but the sense requires *repulsa sint*.

Page 113, line 23. Page 113, line 29. *Electrica omnia alliciunt cuncta, nihil omnino fugant unquam, aut propellunt.* This denial of electrical repulsion probably arose from the smallness of the pieces of electric material with which Gilbert worked. He could hardly have failed to notice it had he used large pieces of amber or of sealing-wax. Electrical repulsion was first observed by Nicolas Cabeus, *Philosophia Magnetica*, Ferrara, 1629; but first systematically announced by Otto von Guericke in his treatise *Experimenta Nova (ut vocantur) Magdeburgica, de Vacuo Spatio* (Amstel., 1672).

Page 113, line 29. Page 113, line 37. *cū de calore quid sit disputabimus.*—The discussion of the nature of heat is to be found in Gilbert's *De Mundo nostro Sublunari* (Amstel., 1651), lib. i., cap. xxvi., pp. 77-88.

Page 115, line 23. Page 115, line 23. *trium vel quatuor digitorum.*—Here as in all other places in Gilbert, *digitus* means a finger's breadth, so that three or four digits means a length of two or three inches, or from six to eight centimetres.

Page 117, line 26. Page 117, line 25. *ille Thebit Bencoræ trepidationis motus.*

"Trepidation in the ancient Astronomy denotes a motion which in the Ptolemaic system was attributed to the firmament, in order to account for

several changes and motions observed in the axis of the world, and for which they could not account on any other principle." (Barlow's *Mathematical Dictionary*.)

Page 118, line 10. Page 118, line 8. *cusps aut lilium*.—Gilbert uses *cusps* or *lilium* always of the North-pointing end of the needle. Sir Thomas Browne speaks of "the lilly or northern point"; but he differs from Gilbert in saying "the *cusps* or Southern point" (*Pseudodoxia Epidemica*, 1650, p. 46). Only in one place (p. 101, line 5) does Gilbert speak of *cusps meridionalis*. Everywhere else the south-pointing end is called the *crux*.

Page 118, line 15. Page 118, line 13. *nam æquè potens est*.—Later observation showed this view to be incorrect. The horizontal component of the earth's magnetic field is not equally strong all over the globe, and the sluggishness of the needle's return to its position of rest is not due to the supporting pin becoming blunt with wear. The value of the horizontal component is zero at the north magnetic pole, and increases toward the magnetic equator. It is greatest near Singapore and in Borneo, being there more than twice as great as it is at London. (See Captain Creak in *Report of Voyage of H.M.S. Challenger, Physics and Chemistry*, vol. ii., part vi., 1889.)

Page 119, line 5. Page 119, line 2. *lapis*.—Both Stettin editions read *lapidis*.

Page 119, lines 9-11. Page 119, lines 7-9. The gift of the whole book is summarized in these lines. They furnish a cardinal example of that inductive reasoning which was practised by Gilbert, and of which Bacon subsequently posed as the apostle. Compare pages 41 and 211.

Page 120, line 8. Page 120, line 5. *dicturi sumus*.—Change of verticity is treated of in book iii., chap. x., pp. 137 to 140.

Page 125, line 24. Page 125, line 29. *appositam*.—All editions give this word, though the sense requires *appositum*.

Page 128, line 9. Page 128, line 11. *non nimis longum*.—The editions of 1628 and 1633 read (wrongly) *minus* instead of *nimis*.

Page 130, line 12. Page 130, line 14. The word *hunc* in the folio of 1600 is corrected in ink to *tunc*, and the Stettin editions both read *tunc*.

Page 132, line 9. Page 132, line 10. *minimus & nullius ponderis*.—The editions of 1628 and 1633 both wrongly read *est* for *&*.

Page 132, line 28. Page 133, line 1. *nutat*.—The editions of 1628 and 1633 both wrongly read *mutat*.

Page 134, line 22. Page 134, line 25. *in rectâ spherâ*.—The meaning of the terms a *right* or *direct sphere*, an *oblique sphere* and a *parallel sphere* are explained by Moxon on pages 29 to 31 of his book *A Tutor to Astronomy and Geography* (Lond., 1686):

"A *Direct Sphere* hath both the *Poles* of the *World* in the *Horizon* . . . It is called a *Direct Sphere*, because all the *Celestial Bodies*, as *Sun*, *Moon*, and *Stars*, &c. By the *Diurnal Motion* of the *Primum Mobile*, ascend directly Above, and descend directly Below the *Horizon*. They that Inhabit under the *Equator* have the *Sphere* thus posited."

"An *Oblique Sphere* hath the *Axis* of the *World* neither *Direct* nor *Parallel* to the *Horizon*, but lies aslope from it."

"A *Parallel Sphere* hath one *Pole* of the *World* in the *Zenith*, the other in the *Nadir*, and the *Equinoctial Line* in the *Horizon*."

Page 136, line 1. Page 136, line 1. *præsenti*.—The editions of 1628 and 1633 read *sequenti*, to suit the altered position of the figure.

Page 137, line 24. Page 137, line 28. *atque ille statim.*—The Stettin editions both wrongly read *illi*.

Page 139. There is a curious history to this picture of the blacksmith in his smithy striking the iron while it lies north and south, and so magnetizing it under the influence of the earth's magnetism. Woodcuts containing human figures are comparatively rare in English art of the sixteenth century; a notable exception being Foxe's *Acts and Monuments* with its many crude cuts of martyrdoms. The artist who prepared this cut of the smith took the design from an illustrated book of Fables by one Cornelius Kiliani or Cornelius van Kiel entitled *Viridarium Moralis Philosophiæ, per Fabulas Animalibus brutis attributas traditæ, etc.* (Coloniæ, 1594). This rare work, of which there is no copy in the British Museum, is illustrated by some 120



fine copper-plate etchings printed in the text. On p. 133 of this work is an etching to illustrate the fable *Ferrarii fabri et canis*, representing the smith smiting iron on the anvil, whilst his lazy dog sleeps beneath the bellows. The cut on p. 139 of Gilbert gives, as will be seen by a comparison of the pictures, just the same general detail of forge and tools; but the position of the smith is reversed right for left, the dog is omitted, and the words *Septentrio* and *Auster* have been added.

In the Stettin edition of 1628 the picture has again been turned into a copper-plate etching separately printed, is reversed back again left for right, while a compass-card is introduced in the corner to mark the north-south direction.

In the Stettin edition of 1633 the artist has gone back to Kiliani's original

plate, and has re-etched the design very carefully, but reversing it all right for left. As in the London version of 1600, the dog is omitted, and the words *Septentrio* and *Auster* are added. Some of the original details—for example, the vice and one pair of pincers—are left out, but other details, for instance, the cracks in the blocks that support the water-tub, and the dress of the blacksmith, are rendered with slavish fidelity.

It is perhaps needless to remark that the twelve copper-plate etchings in the edition of 1628, and the twelve completely different ones in that of 1633, replace certain of the woodcuts of the folio of 1600. For example, take the woodcut on p. 203 of the 1600 edition, which represents a simple dipping-needle made by thrusting a verforium through a bit of cork and floating it, immersed, in a goblet of water. In the 1633 edition this appears, slightly reduced, as a small inserted copper-plate, with nothing added; but in the 1628 edition it is elaborated into a full-page plate (No. xi.) representing the interior, with shelves of books, of a library on the floor of which stands the goblet—apparently three feet high—with a globe and an armillary sphere; while beside the goblet, with his back to the spectator, is seated an aged man, reading, in a carved armchair. This figure and the view of the library are unquestionably copied—reversed—from a well-known plate in the work *Le Diverse & Artificiose Machine* of Agostino Ramelli (Paris, 1558).

In the Emblems of Jacob Cats (*Alle de Wercken*, Amsterdam, 1665, p. 65) is given an engraved plate of a smith's forge, which is also copied—omitting the smith—from Kiliani's *Viridarium*.

Page 140, line 2. Page 140, line 2. *præcedenti*.—This is so spelled in all editions, though the sense requires *præcedente*.

Page 141, line 21. Page 141, line 24. *quod in epistolâ quâdam Italicâ scribitur*.—The tale told by Filippo Costa of Mantua about the magnetism acquired by the iron rod on the tower of the church of St. Augustine in Rimini is historical. The church was dedicated to St. John, but in the custody of the Augustinian monks. The following is the account of it given by Aldrovandi, *Museum Metallicum* (1648, p. 134), on which page also two figures of it are given:

“Aliquando etiam ferrum suam mutat substantiam, dum in magnetem conuertitur, & hoc experientia constat, nam Arimini supra turrin templi S. Ioannis erat Crux a baculo ferreo ponderis centum librarum sustentata, quod tractu temporis adeo naturam Magnetis est adeptum, vt, illius instar, ferrum traheret: hinc magna admiratione multi tenentur, qua ratione ferrum, quod est metallum in Magnetem, qui est lapis transmutari possit; Animaduertendum est id à maxima familiaritate & sympathia ferri, & magnetis dimanare cum Aristoteles in habentibus symbolum facilem transitum semper admiserit. Hoc in loco damus imaginem frusti ferri in Magnetem transmutati, quod clarissimo viro Vlyssi Aldrouando Iulius Caesar Moderatus diligens rerum naturalium inquisitor communicauit; erat hoc frustum ferri colore nigro, & ferrugineo, crusta exteriori quodammodo albicante.” And further on p. 557.

“Preterea id manifestissimum est; quoniam Arimini, in templo Sancti Ioannis, fuit Crux ferrea, quæ tractu temporis in magnetem conuersa est, & ab vno latere ferrum trahebat, & ab altero respuebat.” See also Sir T. Browne's *Pseudodoxia Epidemica* (edition of 1650, p. 48), and Boyle's tract, *Experiments and Notes about the Mechanical Production of Magnetism* (London, 1676, p. 12).

Another case is mentioned in Dr. Martin Lister's *A Journey to Paris* (Lond., 1699, p. 83). "He [Mr. Butterfield] shewed us a Loadstone sawed off that piece of the Iron Bar which held the Stones together at the very top of the Steeple of *Chartres*. This was a thick Crust of Rust, part of which was turned into a strong Loadstone, and had all the properties of a Stone dug out of the Mine. *Mons. de la Hire* has Printed a Memoir of it; also *Mons. de Vallemont* a Treatise. The very outward Rust had no Magnetic Virtue, but the inward had a strong one, as to take up a third part more than its weight unshod." Gassendi and Grimaldi have given other cases.

Other examples of iron acquiring strong permanent magnetism from the earth are not wanting. The following is from Sir W. Snow Harris's *Rudimentary Magnetism* (London, 1872, p. 10).

"In the *Memoirs of the Academy of Sciences* for 1731, we find an account of a large bell at Marseilles having an axis of iron: this axis rested on stone blocks, and threw off from time to time great quantities of rust, which, mixing with the particles of stone and the oil used to facilitate the motion, became conglomerated into a hardened mass: this mass had all the properties of the native magnet. The bell is supposed to have been in the same position for 400 years."

Page 142, line 13. Page 142, line 15. *tunc planetæ & corpora cælestia.*—Gilbert's extraordinary detachment from all metaphysical and ultra-physical explanations of physical facts, and his continual appeal to the test of experimental evidence, enabled him to lift the science of the magnet out of the slough of the dark ages. This passage, however, reveals that he still gave credence to the *nativities* of judicial Astrology, and to the supposed influence of the planets on human destiny.

Page 144, line 14. Page 144, line 14. *ijdem.*—The editions of 1628 and 1633 erroneously read *iisdem*.

Page 147, line 27. Page 147, line 29. *ex optimo aciario.*—Gilbert recommended that the compass-needle should be of the best steel. Though the distinction between iron and steel was not at this time well established, there is no reason to doubt that by *aciarium* was meant edge-steel as used for blades. Barlowe, in his *Magneticall Aduertisements* (Lond., 1616), p. 66, gives minute instructions for the fashioning of the compass-needle. He gives the preference to a pointed oval form, and describes how the steel must be hardened by heating to whiteness and quenching in water, so that it is "brickle in a manner as glasse it selfe," and then be tempered by reheating it over a bar of red hot iron until it is let down to a blue tint. Savery (*Philos. Trans.*, 1729) appears to have been the first to make a systematic examination of the magnetic differences between hard steel and soft iron.

Instructions for touching the needle are given in the *Arte de Nauegar* of Pedro de Medina (Valladolid, 1545, lib. vi., cap. 1).

Page 149, line 8. Page 149, line 9. *per multa sæcula.*—Compare Porta's assertion (p. 208, English edition) "iron once rubbed will hold the vertue a hundred years." Clearly not a matter within the actual experience of either Porta or Gilbert.

Page 153, line 2. Page 153, line 2. *Cardani ab ortu stellæ in cauda vrsæ.*—What Cardan said (*De Subtilitate*, Edit. citat., p. 187) was: "ortum stellæ in cauda ursæ minoris, quæ quinque partibus orientior est polo mundi, respicit."

Page 153, line 21. Page 153, line 26. *sequitur quod versus terram magnam, siue continentem . . . à vero polo inclinatio magnetica fiat.*—Gilbert

goes on to point out how, at that date, all the way up the west European coast from Morocco to Norway, the compass is deflected eastward, or toward the elevated land. He argued that this was a universal law.

In *Purchas his Pilgrimes* (Lond., 1625), in the Narrative, in vol. iii., of Bylot and Baffin's Voyage of 1616, there is mentioned an island between Whale-Sound and Smith's Sound, where there had been observed a larger variation than in any other part of the world. Purchas, in a marginal note, comments on this as follows: "Variation of the Compass 56° to the West, which may make questionable D. Gilbert's rule, tom. I., l. 2, c. 1, that where more Earth is more attraction of the Compass happeneth by variation towards it. Now the known Continents of Asia, &c., must be unspeakably more than here there can be, & yet here is more variation then about Japan, Brasil, or Peru, &c."

Gilbert's view was in truth founded on an incomplete set of facts. At that time, as he tells us, the variation of the compass at London was $11\frac{1}{2}$ degrees eastward. But he did not know of the secular change which would in about fifty-seven years reduce that variation to zero. Still less did he imagine that there would then begin a westward variation which in the year 1816 should reach $24^{\circ} 30'$, and which should then steadily diminish so that in the year 1900 it should stand at $16^{\circ} 16'$ westward. For an early discussion of the changes of the variation see vol. i. of the *Philosophical Transactions* (Abridged), p. 188. Still earlier is the classical volume of Henry Gellibrand, *A Discourse Mathematical on the Variation of the Magneticall Needle* (Lond., 1635). Gilbert heads chapter iii. of book iii. (p. 159) with the assertion *Variatio uniuscuiusque loci constans est*, declaring that to change it would require the upheaval of a continent. Gellibrand combats this on p. 7 of the work mentioned. He says:

"Thus hitherto (according to the Tenents of all our *Magneticall* Philosophers) we have supposed the variations of all particular places to continue one and the same. So that when a Seaman shall happily returne to a place where formerly he found the same variation, he may hence conclude he is in the same former *Longitude*. For it is the Assertion of Mr. Dr. Gilberts. *Variatio uniuscuiusq; Locis constans est*, that is to say, the same place doth alwayes retaine the same variation. Neither hath this Assertion (for ought I ever heard) been questioned by any man. But most diligent magneticall observations have plainly offred violence to the same, and proved the contrary, namely that the variation is accompanied with a variation."

In 1637 Henry Bond wrote in the *Sea-Mans Kalendar* that in the year 1657 the variation would be zero at London. Compare Bond's *Longitude Found* (Lond., 1676, p. 3).

As to inconstancy of the variation in one place see further Fournier's *Hydrographie* (Paris, 1667, liv. xi., ch. 12, p. 413), and Kircher, *Magnes* (Colon. Agripp., 1643, p. 418).

Page 157, line 4. Page 157, line 5. *perfecto*.—Though this word is thus in all editions, it ought to stand *perfecta*, as in line 10 below.

Page 157, line 11. Page 157, line 13. *varietas*, for *variatio*.

Page 160, line 20. Page 160, line 23. *in Borrholubicum*.—This name for the North-west, or North-North-West, is rarely used. It is found on the chart or windrose of the names of the winds on pp. 151 and 152 of the *Mécometrie de l'Eyman* of G. Nautonier (1602). Here the name *Borrolubicus* is given as a synonym for *Nortouest Galerne*, or 'Ολυμπιάς, while the two winds on the points next on the western and northern sides respectively are called *Upocorus* and *Upocircius*.

In Swan's *Specvlvm Mundi* (Camb., 1643, p. 174) is this explanation: "Borrholybicus is the North-west wind."

In Kircher's *Magnes* (Colon. Agripp., 1643, p. 434) is a table of the names of the thirty-two winds in six languages, where *Borrolybicus* is given as the equivalent of *Maestro* or *North-West*.

Page 161, line 2. Page 161, line 2. *Insula in Oceano variationem non mutat.*—The conclusions derived from the magnetic explorations of the Challenger expedition, 1873-1876, are briefly these: That in islands north of the magnetic equator there is a tendency to produce a local perturbation, attracting the north-seeking end of the needle downwards, and horizontally towards the higher parts of the land; while south of the magnetic equator, the opposite effects are observed. (See *Challenger Reports, Physics and Chemistry*, vol. ii., part vi., *Report on the Magnetical Results* by Staff-Commander Creak, F.R.S.)

Page 162, line 2. Page 162, line 3. *quare & respectuum punctum . . . excogitauit.*—The passage referred to is in *The newe Attractive* of Robert Norman (Lond., 1581), chap. vi.

"Your reason towards the earth carrieth some probabilitie, but I prove that there be no *Attractive*, or drawing propertie in neyther of these two partes, then is the *Attractive* poynt lost, and falsly called the poynt *Attractive*, as shall be proved. But because there is a certayne point that the Needle alwayes respecteth or sheweth, being voide and without any *Attractive* propertie: in my judgment this poynt ought rather to bee called the point *Respective* . . . This Poynt *Respective*, is a certayne poynt, which the touched Needle doth alwayes *Respect* or shew . . ."

Page 165, line 2. Page 165, line 2. *De pyxidis nauticæ vñitate compositione.*—Gilbert's description of the usual construction of the mariner's compass should be compared with those given by Levinus Lemnius in *The Secret Miracles of Nature* (London, 1658); by Lipenius in *Navigatio Salomonis Ophiritica* (Witteb., 1660, p. 333); and with that given in Barlowe's *Navigators Supply* (London, 1597). See also Robert Dudley's *Dell' Arcano del Mare* (Firenze, 1646).

Page 165 deals with the construction; the process of magnetizing by the loadstone had already been discussed in pp. 147 to 149. It is interesting to see that already the magnetized part attached below the compass-card was being specialized in form, being made either of two pieces bent to meet at their ends, or of a single oval piece with elongated ends. The marking of the compass-card is particularly described. It was divided into thirty-two points or "winds," precisely as the earlier "wind-rose" of the geographers, distinguished by certain marks, and by a lily—or fleur-de-lys—indicating the North. Stevin in the *Havenfinding Art* (London, 1599), from which work the passage on p. 167 is quoted, speaking on p. 20 of "the Instrument which we call the Sea-directorie, some the nautical box, . . . or the sea compasse," mentions the "Floure de luce" marking the North.

The legend which assigns the invention of the compass to one Goia or Gioja of Amalfi in 1302 has been already discussed in the Note to page 4. Gilbert generously says that in spite of the adverse evidence he does not wish to deprive the Amalfians of the honour of the construction adopted in the compasses used in the Mediterranean. But Baptista Porta the Neapolitan, who wrote forty years before Gilbert, discredited the legend. "*Flavius* saith, an Italian found it out first, whose name was *Amalphus*, born in our

Campania. But he knew not the Mariners Card, but stuck the needle in a reed, or a piece of wood, cross over; and he put the needles into a vessel full of water that they might float freely." (Porta's *Natural Magick*, English translation, London, 1658, p. 206.) See also Lipenius (*op. citat.*, p. 390).

The pivoting of the needle is expressly described in the famous *Epistle* on the Magnet of Peter Peregrinus, which was written in 1269. Gasser's edition, *Epistola Petri Peregrini . . . de magnete*, was printed in Augsburg in 1558. In Part II., cap. 2, of this letter, a form of instrument is described for directing one's course to towns and islands, and any places in fact on land or sea. This instrument consists of a vessel like a turned box (or *pyxis*) of wood, brass, or any solid material, not deep, but sufficiently wide, provided with a cover of glass or crystal. In its middle is arranged a slender axis of brass or silver, pivotted at its two ends into the top and the bottom of the box. This axis is pierced orthogonally with two holes, through one of which is passed the steel needle, while through the other is fixed square across the needle another stylus of silver or brass. The glass cover was to be marked with two cross lines north-south and east-west; and each quadrant was to be divided into ninety degrees. This the earliest described pivotted compass was therefore of the cross-needle type, a form claimed as a new invention by Barlowe in 1597. The first suggestion of suspending a magnetic needle by a thread appears to be in the *Speculum Lapidum* of Camillus Leonardus (Venet., 1502, fig. k ij, lines 25-31): "Nā tacto ferro ex una pte magnetis ex opposita eius pte appropinquato fugat: ut expētia docet de acu appenso filo."

The earliest known examples of the "wind-rose" are those in certain parchment charts preserved in the Biblioteca Marciana in Venice. These go back to 1426 or 1436, the best being ascribed to Andrea Bianco. They have the North indicated by a fleur-de-lys, a trident, a simple triangle, or a letter T; while the East is distinguished by a cross. The West is marked with a P. (see Fincati, *op. citat.*). The eight marks in order, clockwise, run thus,

⚔ (or T). G. ⚔ (or L) S. O. A (or L). P. M.

The letters correspond to the Italian names of the principal winds:

Tramontano	North.
Greco	North-East.
Levante	East.
Sirocco	South-East.
Ostro	South.
Africo or Libeccio	South-West.
Ponente	West.
Maestro	North-West.

Wind-roses marked with the names of the minor winds are found in Nautonier's *Mécometrie de l'Eyman* (Vennes, 1602-1604, pp. 151-152), and Kircher's *Magnes Siue de Arte Magnetica* (Colon. Agripp., 1643, p. 432). The description above given of the early Venetian wind-roses *exactly* describes the compass-card as depicted by Pedro de Medina in his *Arte de Nauegar* (Valladolid, 1545, folio lxxx.), in the sixth book entitled "las aguias de navegar"; while in the *Breve compendio de la sphaera* of Martin Cortes (Sevilla, 1551, cap. iii., *de la piedrayman*) a similar wind-rose, without the letters, is found.

In the *De Ventis et navigatione* of Michael Angelo Blondo (Venet., 1546, p. 15) is given a wind-rose, described as "Pixis uel Buxolus instrumentum et dux nauigantium," having twenty-six points inscribed with the names of the winds, there being six between north and east, and six between south and west, and only five in each of the other quadrants. In the middle is a smaller wind-rose exactly like the early Italian ones just mentioned.

In the *Della Guerra di Rhodi* of Jacobo Fontano (Venet., 1545, pages 71-74) is a chapter *Dei Venti, e della Bussola di nauicare di Giovanni Quintino*, giving a wind-rose, and a table of the names of the winds, the north being indicated by a pointer, at the cusp of which are seven stars, and the west by an image of the sun. The other cardinal points are marked with letters.

Barlowe, in *The Navigators Supply* (Lond., 1597), speaks thus:

"The merueilous and diuine Instrument, called the *Sayling Compasse* (being one of the greatest wonders that this World hath) is a Circle diuided commonly into 32. partes, tearmed by our Seamen Windes, *Rumbes*, or Points of *Compasse*."

It is a disputed point with whom the method of naming the winds originated. Some ascribe it to Charlemagne. Michiel Coignet (*Instruction nouvelle . . . touchant l'art de naviguer*, Anvers, 1581, p. 7) ascribes it to Andronicus Cyrrhestes. See Varro, *De Re Rustica*, iii., 5, 17, and Vitruvius, i., 6, 4.

Gilbert's complaint of the evil practice of setting the needles obliquely beneath the card, with the intention of allowing for the variation, is an echo of a similar complaint in Norman's *Newe Attractione*. In chapter x. of this work Norman thus enumerates the different kinds of compasses:

"Of these common Sayling Compasses, I find heere (in *Europa*) five sundry fortes or sets. The first is of *Leuant*, made in *Scicile*, *Genoia*, and *Venice*: And these are all (for the most parte) made Meridionally, with the Wyers directlye sette under the South, and North of the *Compasse*: And therefore, duely shewing the poynt *Respective*, in all places, as the bare Needle. And by this *Compasse* are the Plats made, for the most part of all the *Leuants* Seas.

"Secondly, there are made in *Danyske*, in the Sound of *Denmarke*, and in *Flanders*, that have the Wyers set at 3 quarters of a point to the Eastwards of the North of the compass, and also some at a whole point: and by these Compasses they make both the Plats and Rutters for the Sound.

"Thirdly, there hath beene made in this Countrey particularly, for Saint *Nicholas* and *Ruscia*, Compasses set at 3 seconds of a point, and the first Plats of that Discoverie were made by this *Compasse*.

"Fourthly the *Compasse* made at *Sevill*, *Lisbone*, *Rochell*, *Bourdeaux*, *Roan*, and heere in *England*, are moste commonly set at halfe a point: And by this *Compasse* are the Plats of the East and West *Indies* made for their Pylotes, and also for our Coastes neere hereby, as *France*, *Spayne*, *Portugall*, and *England*: and therefore best of these Nations to bee used, because it is the most common forte that is generally used in these Coastes."

Bessard (*op. citat.*, pages 22 and 48) gives cuts of compasses showing the needle displaced one rumb to the East.

Gallucci, in his *Ratio fabricandi horaria mobilia et permanentia cum magnetica acu* (Venet., 1596), describes the needle as inclined 10 degrees from the south toward the south-west.

The frontispiece of the work of Pedro Nuñez, *Instrumenta Artis Navigandi*, Basil., 1592, depicts a compass with the lily set one point to the east.

Reibelt, *De Physicis et Pragmaticis Magnetis Mysteriis* (Herbipolis, 1731), depicts the compass with the needle set about 12 degrees to the East of North. See also Fournier, *Hydrographie* (Paris, 1667); De Lanis, *Magisterium Naturæ et Artis* (Brixia, 1684); Milliet Deschales, *Curfus seu Mundus*

Mathematicus (Lugd., 1674). Both the latter works give pictures of the compass-cards as used in South Europe, and in North Europe, and of the various known shapes of needles.

Page 168, line 29. Page 168, line 33. *Directio igitur inualidior est propè polos.* Here as in many passages *direction* means *the force which directs*. A similar usage prevails with the nouns *variation* and *declination*, meaning frequently the force causing variation or declination respectively.

Page 172, line 13. *perquirere.* The edition of 1633 reads *perquirero*, in error.

Page 172, line 29. Page 172, line 33. *Ad pyxidis nauticæ veræ & meridionalis formam . . . fiat instrumentum.*—An excellent form of portable meridian compass, provided with sights for taking astronomical observations, is described by Barlowe (*The Navigators Supply*, London, 1597), and is depicted in an etched engraving. An identical engraving is repeated in Dudley's *Arcano del Mare* (Firenze, 1646). Gilbert's new instrument was considerably larger.

Page 174, line 19. Page 174, line 21. *addendo vel detrahendo prostaphæresin.*—"Prosthaphæresis, conflata dictione, ex additione et subtractione speciebus logistiques, nomen habet ab officio, quia vt in semicirculo altero ad æquabilem motum adijcitur, ita in altero subtrahitur, vt adparens motus ex æquabili taxetur: atque hinc fit, quòd quæ Prosthaphæresis dicitur Ptolemæo, ea vulgò æquatio vocetur." (Stadius, *Tabulæ Bergenses*, Colon. Agripp., 1560, p. 37.)

Page 174, line 28. Page 174, line 31. *Stellæ Lucidæ.*—According to Dr. Marke Ridley (*Magneticall Animadversions*, London, 1617, p. 9), this chapter xii. of book iv., with the Table of Stars, was written by Edward Wright, the author of the Prefatory Epistle of *De Magnete*. Wright was Lecturer on Navigation to the East India Company, and author of sundry treatises on Navigation.

Page 187, line 14. Page 187, line 16. *hic qui versus boream constitit . . . meridionalis est, non borealis, quem antè nos omnes existimabant esse borealem.*—Earlier on, on pages 15 and 125, Gilbert had mentioned this point. His insistence caused Barlowe (*Magneticall Aduertisements*, 1616, p. 4) to speak of the south-pointing end of the needle as the "true North," and thereby drew on himself the animadversions of Marke Ridley.

Page 188, line 15. Page 188, line 16. *in rectâ spherâ.*—See note to p. 134.

Page 190, line 14. Page 190, line 19. *declinans in Borealibus.*—Dipping as it does in northern regions; that is, with the north-seeking or true-south pole downward.

Page 195, line 20. Page 195, line 24. *multa maiora pondera.*—Many greater weights. All editions read *multa*, but the sense requires *multo*: "much greater weights."

Page 196, line 10. Page 196, line 12. *constans est.*—This must not be read "is constant," for it is constant only in any given latitude.

Page 196, line 15. Page 196, line 18. *De proportionè declinationis pro latitudinis ratione.*—Gilbert here announces, and proceeds in the next seven pages to develop, the proposition that to each latitude there corresponds a constant dip to a particular number of degrees. If this were accurately so, then a traveller by merely measuring the dip would be able to ascertain, by calculation, by reference to tables, or by aid of some geometrical appliance,

the latitude of the place. In this hope Gilbert sought to perfect the dipping-needle; and he also worked out, on pages 199 and 200, an empirical theory, and a diagram. This theory was still further developed by him, and given to Thomas Blundevile (see the Note to p. 240). Briggs of Gresham College, on Gilbert's suggestion, calculated a table of Dip and Latitude on this theory. It was found, however, that the observed facts deviated more or less widely from the theory. Kircher (*Magnes*, 1643, p. 368) gives a comparative table of the computed and observed values. Further discovery showed the method to be impracticable, and Gilbert's hope remained unfulfilled.

Page 197, line 18. Page 197, line 21. *progressionis centri*.—Note Gilbert's precision of phrase.

Page 200, line 12. Page 200, line 11. *subintelligitur*.—This is printed *subintelligitur*, and is altered in ink in all copies of the folio edition. The editions of 1628 and 1633 read *subintelliguntur*. Similarly in line 14 the word *ducit* has had a small *r* added in ink, making it read *ducitur*, as also the other editions.

Page 203. This figure of the experiment with the simple dipping needle suspended in water in a goblet is due to Robert Norman. In his *Newe Attractive* (London, 1581, chap. vi.) he thus describes it:

"Then you shall take a deepe Glasse, Bowle, Cuppe, or other vessell, and fill it with fayre water, setting it in some place where it may rest quiet, and out of the winde. This done, cut the Corke circumspectly, by little and little, untill the wyre with the Corke be so fitted, that it may remain under the superficies of the water two or three inches, both ends of the wyer lying levell with the superficies of the water, without ascending or descending, like to the beame of a payre of ballance beeing equalie poysed at both ends.

"Then take out of the same the wyer without mooving the Corke, and touch it with the Stone, the one end with the South of the Stone, and the other end with the North, and then set it againe in the water, and you shall see it presentlie turne it selfe upon his owne Center, shewing the aforefay'd Declining propertie, without descending to the bottome, as by reason it should, if there were any *Attraction* downwards, the lower part of the water being neerer that point, then the superficies thereof."

Page 212, line 7. Page 212, line 8. *ex altera parte*.—The sense seems to require *et altera parte*, but all editions read *ex*.

Page 213, line 1. Page 213, line 2. The passage here quoted from Dominicus Maria Ferrariensis, otherwise known as the astronomer Novara, does not occur in any known writing of that famous man. It is, however, quoted as being by Novara in at least three other writings of the same epoch. See the *Tabula secundorum mobilium coelestium* of Maginus (Venet., 1585, p. 29, line 19 to p. 30, line 11); the *Eratosthenes Batavus* of Willebrord Snell (Lugd. Batav., 1617, pp. 40-42); and the *Almagesti novi (Pars Posterior)* of Riccioli (Bonon., 1651, p. 348). The original document appears to have perished. See a notice by M. Curtze in Boncompagni's *Bullettino di Bibliografia*, T. iv., April, 1871.

Page 214, line 26. Page 214, line 31. *Philolaus Pythagoricus*.

"Philolaüs a le premier dit que la terre se meut en cercle; d'autres disent que c'est Nicéas de Syracuse."

"Les uns prétendent que le terre est immobile; mais Philolaüs le pythagoricien dit qu'elle se meut circulairement autour du feu (central) et suivant un cercle oblique, comme le soleil et la lune."—(Chaignet, *Pythagore et la Philosophie pythagoricienne*, Paris, 1873.)

It appears that the first of these *dicta* is taken from Diogenes Laërt., viii. 85; and the second from Plutarch, *Placit. Philos.*, III. 7. The latter

passage may be compared with Aristotle, *De Coelo*, II. 13, who, referring to the followers of Pythagoras, says: "They say that the middle is fire, that the earth is a star, and that it is moved circularly about this centre; and that by this movement it produces day and night."

Page 214, line 34. Page 214, line 42. *Copernicus*.—His work is *De revolutionibus orbium coelestium, libri vi.* (Basil., 1566).

Page 215, line 27. Page 215, line 24. *quæ . . . in cælo varijs distantijs collocata sunt*.—This remark appears to be Gilbert's one contribution to the science of Astronomy; the stars having previously been regarded as fixed in the eighth sphere all at the same distance from the central earth, around which it revolved.

Page 220, line 6. Page 220, line 6. *quem nycthemeron vocamus*.—The 1628 and 1633 editions read *nyctemoron*.

Page 221, line 10. Page 221, line 11. *poli verè oppositi sint*.—For *verè*, the 1628 and 1633 editions read *rectæ*. All editions read *sint*, though *sunt* seems to make better sense.

Page 223, line 7. Page 223, line 8. *ad telluris conformitatem*.—The word *conformitas* is unknown in classical Latin.

Page 223, line 16. Page 223, line 17. *Omitto quod Petrus Peregrinus constanter affirmat, terrellam super polos suos in meridiano suspensam, moveri circulariter integrâ revolutione 24 horis: Quod tamen nobis adhuc videre non contingit; de quo motu etiam dubitamus*.

This statement that a spherical loadstone pivotted freely with its axis parallel to the earth's axis will of itself revolve on its axis once a day under the control of the heavens, thus superseding clocks, is to be found at the end of chap. x. of Peregrinus's *Epistola De Magnete* (Augsb., 1537).

Gilbert, who doubted this experiment because of the stone's own weight is taken to task by Galileo, in the third of his Dialogues, for his qualified admission.

"I will speak of one particular, to which I could have wished that Gilbert had not lent an ear; I mean that of admitting, that in case a little Sphere of Loadstone might be exactly librated, it would revolve in it self; because there is no reason why it should do so" (p. 376 of Salusbury's *Mathematical Collections*, London, 1661). The Jesuit Fathers who followed Gilbert, but rejected his Copernican ideas, pounced upon this pseudo-experiment, as though by disproving it they had upset the Copernican theory.

Page 227, line 6. Page 227, line 7. This line is left out in the 1628 edition. In the 1633 edition it was also left out by the printer, and subsequently printed in in the margin, being page 219 of that edition.

Page 234, line 35. Page 234, line 40. *ut poli telluris respectus à polis*.—If it may be permitted to read *respectu* for *respectus* the sense is improved, and the passage may then be translated thus: "that just as it was needful . . . that the poles of the Earth as to direction should be 23 degrees and more from the poles of the Ecliptick; so now, &c."

Page 237, line 19. Page 237, line 22. *ut motus quidem obscuri saluarentur*.—It has been conjectured that *quidem* is here a misprint for *quidam*, but the adverb *quidem* adds a satirical flavour to his argument against the folly of those who held the doctrine of the moving spheres. The verb *salvare* does not occur in classical Latin.

Page 240, line 13. Page 240, line 17. *à Copernico (Astronomiæ instauratore)*.—Gilbert was the first in England to uphold the doctrines of

Copernicus as to the motion of the earth on its axis and its revolution around the sun. He considered that his magnetic observations brought new support to that theory, and his views are quoted with approbation by Kepler, *Epitome Astronomiæ Copernicanæ* . . . Authore Ioanne Keplero . . . (Francofurti, 1635); and by Galileo, *Dialogus de Systemate Mundi* (Augustæ Treboc., 1635), an English translation of which appeared in Salusbury's *Mathematical Collections and Translations* (London, 1661, pp. 364 to 377).

For this the book *De Magnete* was considered by many as heretical. Many of the copies existing in Italy are found to be either mutilated or else branded with a cross. For example, the copy in the library of the Collegio Romano in Rome has book VI. torn out. Galileo states that the Book of Gilbert would possibly never have come into his hands "if a Peripatetick Philosopher, of great fame, as I believe to free his Library from its contagion, had not given it me." In England Barlowe, in his *Magneticall Aduertisements* (1616), expressly repudiated Gilbert's Copernican notions, while praising his discoveries in magnetism. Marke Ridley, while upholding Gilbert's views, in his *Magneticall Animadversions* (1617) did not consider him "skilfull in Copernicus." The Jesuit writers, Cabeus, Kircher, Fonseca, Grandamicus, Schott, Leotaudus, Millietus, and De Lanis, one and all, who followed Gilbert in their magnetic writings, repudiated the idea that the magnetism of the globe gave support to the heretical modern Astronomy.

The works referred to are:

Cabeus, *Philosophia Magnetica, in qua Magnetis natura penitus explicatur* . . . auctore Nicolao Cabeo Ferrarenfi Soc. Jesu. (Ferrariæ, 1629).

Kircher, *Magnes, Siue de Arte Magnetica, Libri tres, Authore Athanasio Kirchero* . . . e Soc. Jesu. (Romæ, 1641).

Grandamicus, *Nova Demonstratio immobilitatis terræ petita ex virtute magnetica* (Flexiæ, 1645). This work is most beautifully illustrated with copper-plate etchings of cupids making experiments with terrellas.

Schott, Gaspar, *Thaumaturgus Physicus* (Herbipolis, 1659).

Leotaudus, R. P. *Vincentinii Leotaudi Delphinatis, Societ. Jesu., Magnetologia; in qua exponitur Nova de Magneticis Philosophia* (Lugduni, 1668).

Millietus (Milliet Deschaes), *Cursus seu Mundus Mathematicus* (Lugd., 1674), *Tomus Primus, Tractatus de Magnete*.

De Lanis, *Magisterium Naturæ et Artis. Opus Physico-Mathematicum P. Francisci Tertii de Lanis, Soc. Jesu.* (Brixia, 1684).

Page 240, line 24. Page 240, line 31. *hinc finem & periodum imponimus.*

On February 13 [1601] Gilbert wrote to Barlowe (see *Magneticall Aduertisements*, p. 88):

"I purpose to adioyne an appendix of six or eight sheets of paper to my booke after a while, I am in hand with it of some new inventions, and I would haue some of your experiments, in your name and inuention put into it, if you please, that you may be knownen for an augmenter of that arte."

This he never did. Perhaps his appointment (in February, 1601) as chief physician in personal attendance on the Queen interfered with the project; or his death, of the plague, in 1603, intervened before his intention had been carried into effect. But it is probable that the substance of the proposed additions is to be found in the chapter, published in Gilbert's lifetime, in Blundevile's *Theoriques of the seuen Planets* (London, 1602), thus described in the title-page of the work: "There is also hereto added,

The making, description, and vse, of two most ingenious and necessarie Instruments for Sea-men, to find out thereby the latitude of any Place vpon the Sea or Land, in the darkeſt night that is, without the helpe of Sunne, Moone, or Starre. Firſt inuented by M. Doctör Gilbert, a moſt excellent Philoſopher, and one of the ordinarie Phyſicians to her Maieſtie: and now here plainly ſet downe in our mother tongue by Maſter Blundeuile."

Of theſe two instruments the firſt conſiſts of a mechanical device, with movable quadrants, to be cut out in cardboard, to be uſed in connection with the diagram of ſpiral lines which Gilbert had given as a folding plate between pages 200 and 201 of *De Magnete*. The intention was that the Sea-man having found by experiment with a dipping-needle the amount of the dip at any place, ſhould by applying this diagram and its moving quadrants, aſcertain the latitude, according to the theory expounded in book V., chap. VII.

The ſecond instrument is a ſimplified portable dipping-needle, having the degrees engraved on the inner face of a cylindrical braſs ring.

Blundeuile adds a Table, calculated by Briggs, and "annexed to the former Treatiſe by *Edward Wright*, at the motion of the right Worſhipful M. Doctör *Gilbert*." This gives the values of the dip for different latitudes, as calculated from Gilbert's empirical theory.

The other work, *De Mundo noſtro Sublunari Philoſophia Nova*, which Gilbert left in manuſcript at his death, does not contain any additional matter on the magnetical investigations. Though it contains ſeveral direct references to the *de Magnete*, and particularly to Book VI. on the rotation of the earth, it is doubtful whether it was written after or before the publication of *de Magnete*. On pages 137 to 144 of the poſthumous edition (Amſterdam, 1651) Gilbert refers to Peregrinus's alleged perpetually revolving ſphere, and denies its poſſibility. The greater part of the work is an anti-Ariſtotelian diſcuſſion on Air, Meteorology, Aſtronomy, the Winds, Tides, and Springs.



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